FLIGHT and The AIRCRAFT ENGINEER

First Aeronautical Weekly in the World : Founded 1909

Editor C. M. POULSEN

Managing Editor G. GEOFFREY SMITH, M.B.E.

Chief Photographer JOHN YOXALL

Editorial, Advertising and Publishing Offices: DORSET HOUSE, STAMFORD STREET, LONDON, S.E.1
Telegrams: Truditur, Sedist, London. Telephone: Waterloo 3333 (35 lines).

COVENTRY: 8-10, CORPORATION ST. Telegrams: Autocar, Coventry. Telephone: Coventry 5210.

BIRMINGHAM, 2: GUILDHALL BUILDINGS, NAVIGATION ST. Telegrams: Autopress, Birmingham. Telephone: Midland 2971 (5 lines).

MANCHESTER, 3: 260, DEANSGATE. Telegrams: Iliffe, Manchester. Telephone: Blackfriars 4412.

GLASGOW, C.2: 26B, RENFIELD ST. Telegrams: Iliffe, Glasgow. Telephone: Central 4857.

SUBSCRIPTION RATES: Home and Abroad: Year, £3 1 0. 6 months, £1 10 6. 3 months, 15s. 3d.
Registered at the G.P.O. as a Newspaper.

No. 1732. Vol. XLI. MARCH 5th, 1942. Thursdays, One Shilling.

The Outlook

Bombing Policy

IN his first speech as leader of the House of Commons Sir Stafford Cripps made a very good impression. When a major change is made in the composition of the Government, one hopes to see evidence that draughts of fresh air are blowing through the offices in Whitehall, and particularly that the advent of new men means consideration of new ideas. Sir Stafford showed that these hopes will be fulfilled.

It usually happens that a change of policy is disappointing to many who have come to think entirely along well-worn grooves, and Sir Stafford must have given a severe shock to all who have pinned their faith to the theory of final victory by strategic bombing. *Flight* has always protested against that theory, and was gratified to note that Lord Trenchard the other day agreed that the Air Force cannot win the war by itself. There are signs that this doubt about the overwhelming effect of strategic bombing is making headway among thinking men, and in the debate on the day before Sir Stafford made his speech two Honourable Members, Col. Macnamara and Professor A. V. Hill, had expressed doubts, or rather more than doubts, about the efficacy of the effort expended in bombing German production. When, a few days before, the Prime Minister put it down that one of the advantages which we derived from the escape of the German warships from Brest was that Bomber Command would no longer be diverted from its campaign against German production by the need to make frequent visits to Brest, we may take it that he was trying to extract what comfort was possible from an uncomfortable position.

Sir Stafford Cripps was very frank. He said that our bombing policy was initiated at a time when we were fighting alone against the combined forces of Germany and Italy, and it then seemed the most effective way in which we, acting alone, could take an initiative against the enemy. That is a confession that the policy was from the outset one of *faute de mieux*, not regarded as a certain road to victory. Now that the Russian armies were shaking Hitler's land power, the original policy, said Sir Stafford, had come under review. The Government were fully aware of the other uses to which our resources could be put, and when they decided that a change of policy ought to be made, that change would be made.

The Needs of the Army

WE have many times commented in these columns on the phenomenon that the British strategic bombing of Germany has never prevented Hitler from moving his armies wherever he wanted them, and that they have always had a sufficiency of all descriptions of supplies. Other points to which we have drawn attention have been the immunity of many German aircraft factories from British air attack, and the invariable shortage of suitable air support from which every British field force has suffered, and suffered grievously. Even in Libya, where the co-ordination of Army and Air Force has been far better than in any other theatre, the battle was engaged without aircraft suitable for dealing with German heavy tanks.

To the first of these points the reply of the enthusiastic exponents of the bombing policy has been that the numbers of our heavy bombers must be multiplied by *x*, and that when that had been accomplished we

should paralyse the German war effort at its source. The time has come for considering whether it is right and wise to aim at such an enormous increase of our strength in heavy bombers to the detriment of other weapons.

Germany, including the conquered countries of Austria, Czechoslovakia, Poland, etc., is an enormous country, and the number of heavy bombers which would be needed to put even 50 per cent. of German factories out of action must be simply staggering. Attacks on communications would seem more promising, but roads, railways and canals are all repairable in reasonable time. Only a ship which is sunk is a definite final loss to German transport. Again we repeat that Hitler has always been able to mass his forces wherever he wanted them.

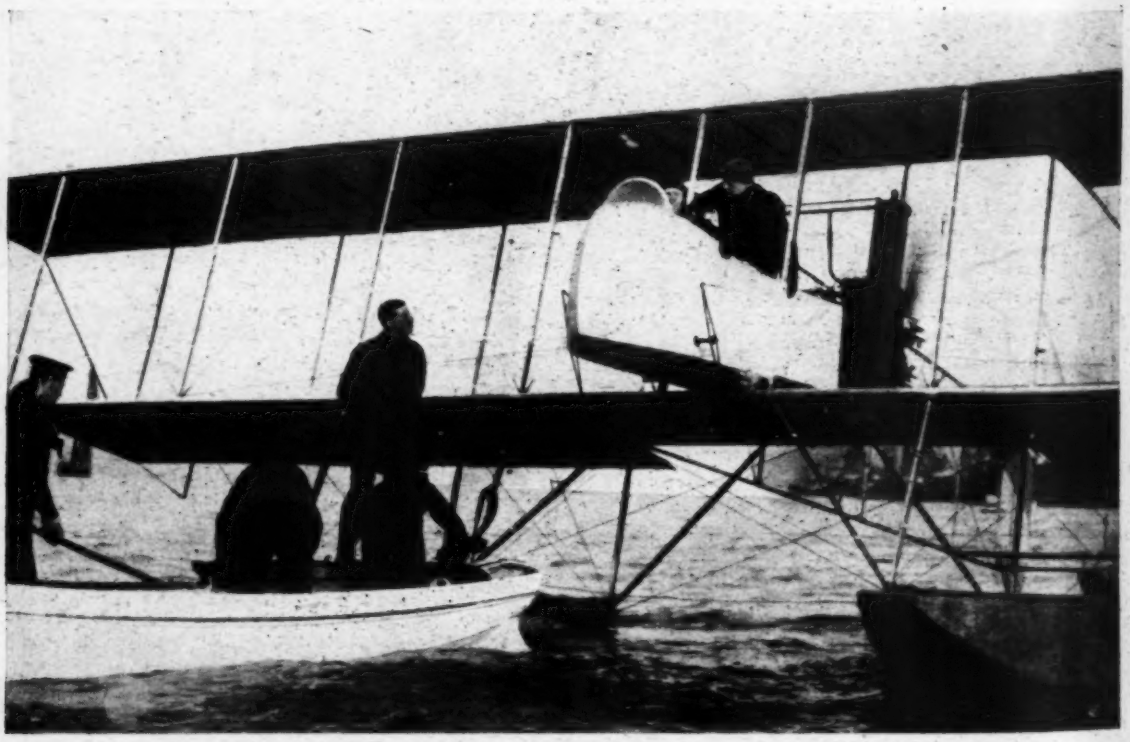
In the meantime, our land forces have never had sufficient air support, or, at least, sufficient air support of the right kind. Mr. Churchill has said several times that the governing factor has been shipping. We do not question his candour, but several times it seemed that he was only alluding to the supply of Hurricanes and other fighters, of which it is understood that we have ample supplies. An army needs more than fighters, essential though they are. Nobody seems yet to have decided definitely what the British Army does want in the way of aircraft. Some months ago the Minister of Aircraft Production (then Col. Moore-Brabazon) told the House of Commons that he had received no request from the Army for dive-bombers. On February 2nd Sir Archibald Sinclair stated that specialised dive-bombers were being produced for the R.A.F. in America, but had not yet reached our squadrons. Probably it is wise to trust to American experience gained by their "Attack" section, but it certainly seems that here there has been a deplorable delay.

The new Government, it is to be hoped, will review the whole field of our air effort, and see to it that energy is not expended on objects which do not pay good dividends, and in particular that British field forces shall in the future not have to fight without air support of the right kind and in adequate strength.

Parachute Troops Again

THE satisfaction which will be generally felt in the country over the brilliant exploits of British parachute troops should not centre on the destruction of one German radiolocation station. It ought not to have been impossible to bomb it with less expenditure of energy and risk; and doubtless the Germans will build another before very long. The main ground for gratification is the perfection of the staff work between the three Services, and the accuracy with which everything was carried out "according to plan."

In addition to this must be counted the exhilarating effect of the adventure on the Forces engaged. Troops, like foxhounds, need to be blooded every now and again if they are to maintain their keenness. Our parachute troops have been engaging in concentrated training for some considerable time past, and they must have been wondering when their specialised abilities would be put to the proof. This raid will have shown them that the lines of their training have been sound, and that they are able to do what they have been taught that they would be able to do. Any tendency to staleness will have now vanished, and all their comrades will be likewise encouraged.



THE FIRST LORD OF THE ADMIRALTY IN NAVY SEAPLANE No. 95 IN PORTSMOUTH HARBOUR PRIOR TO HIS ASCENT LAST MONDAY: No, not Mr. Alexander but Mr. Winston Churchill in 1914. The picture and caption are from *Flight* of February 28th of that year. The pilot was Lt. Longmore (now Air Chief Marshal Sir Arthur Longmore, Inspector-General of the R.A.F.) and the aircraft a Maurice Farman seaplane with Canton-Unné radial water-cooled engine. Mr. Churchill made flights over the Fleet, and a picture on page 212 shows the seaplane over the former *Prince of Wales*.

War in the Air

Curtiss Hawks of the Royal Netherlands East Indies Air Force in formation over Java.

Air Fights Over Rangoon : Many Japanese Machines Lost : Fate of Invasion Fleet off Bali : The "Scharnhorst" and "Gneisenau"

THERE has been a great air battle over Burma in which the honours were shared by the R.A.F. and that splendid band of airmen, the A.V.G. (American Volunteer Group). These fighters tackled a large formation of Japanese bombers with fighter escort, and shot down a number of them, provisionally estimated at 30. British bombers the same day sank two Japanese river boats near Moulmein. By land the Indian forces are slowly withdrawing, fighting fiercely, and giving as well as suffering heavy casualties. Some of the Indian units are veterans from Keren, and they are said to be quite undeterred by the Japanese bombing and shelling. They proved that they could stand up to the latter in 1914-1915, when they held trenches in Flanders. Bombing had not become a great infliction in those days. It is only right that the British public should have some idea of what manner of men these are who are fighting so bravely for the Empire, and we may be pardoned for interpolating that among those who have done particularly well are Gurkhas from Nepal, Dogras, who are Hindus from the foothills of the Punjab, and Baluchis, who are Mussulmans from Baluchistan, which lies south of Afghanistan and east of Persia on the Indian Ocean. The Indian Air Force, a new and undeveloped body, has also been in action on the Burma front, but it has only been mentioned as taking part in reconnaissances.

In our last issue we mentioned that the Japanese had failed in their first attempts to master the island of Bali, just to the east of Java. They have since succeeded, but at the cost of a good many vessels lost or damaged by the combined sea and air attack of the United Nations. The Dutch believe that one cruiser and one transport were sunk, and six cruisers and one transport were damaged. American airmen reported that they sighted the fleet as it made off for home, and they only

DISPERSAL POINT: A Merlin-engined Beaufighter II, belonging to a R.C.A.F. fighter squadron, being refuelled.

OVER THE DESERT: Bristol Blenheims of the Middle East Command in formation. The view is that of the second pilot.

saw four ships, two cruisers and two destroyers, of which one cruiser and one destroyer were in tow. Presumably the other survivors had gone on ahead. One wonders how the Japanese are going to keep their troops supplied on all the islands which they have occupied. The Japanese soldier is a frugal person who can live on the rice which he will find in the Malay villages, but ammunition is not to be picked up in that way. Three other large Japanese transports were sunk by Allied airmen near Macassar.

More Fighters Wanted

OF course, Japanese raids have been constant over Java and other Dutch islands, and where there were no air defences there has been machine-gunning of civilians in the streets. The Japanese have nothing to learn from the senior partner of the Axis in the way of brutality. Naval parachute troops are said to have landed on the island of Timor. The Portuguese troops did not arrive in time to protect their half of the island; and the British and Dutch were not there in sufficient strength.

From Java goes up the regular cry for more fighters. American P40s have been in action over the naval base of Surabaya, and have done wonders. One day they tackled 52 Japanese bombers escorted by 40 fighters, and did some damage. But it is almost pathetic to read of another fight in which the Americans numbered only seven. None the less they turned back a superior Japanese formation and bagged a few of them without loss to themselves.

On the day following the Rangoon air battle mentioned above, in which the Japanese lost at least 30 machines, there was another resounding victory for the R.A.F. and Americans in the same area. This time 21 enemy machines were brought down. The Japanese no doubt have strong air forces, but over 50 lost in two days is enough to make any commander think. They are said to be constructing airfields in northern Siam, opposite to where the Chinese troops are lying, and developments in that region are probable before long.

It is good news that some 5,000 civilians have been evacuated from Rangoon by sea. The trip across the Bay of Bengal to India is not now a pleasure cruise, and most of the ships were attacked by Japanese aircraft. Although it is improbable that the ships were armed, none was hit by the enemy's bombs. Evidence is accumulating that the Japanese are not good bomb-aimers.

General Wavell's love for flying about the world has cost him a broken rib. He visited Singapore just before the surrender, and his machine had an accident when taking off on the return journey. The accident has not kept him from his work, though he must be suffering pain from the fracture.

The German Warships

AIR reconnaissance has now proved that neither the *Scharnhorst* nor the *Gneisenau* got through the Channel unscathed. Both are laid up, one in dry dock at Kiel, the other in the dockyard at Wilhelmshaven. It is not possible to say whether the wounds inflicted on them came from air torpedoes or marine torpedoes, and we must hope that some of the latter found their mark, as they do heavier damage. The *Prinz Eugen* seems to have escaped the risks of the Channel passage, but she has since been hit by a torpedo from the submarine H.M.S. *Trident*, and will certainly need prolonged repairs before she is fit for sea again. That is no small consolation for the rebuff which our forces suffered when the ships made their way through the Channel without being sunk outright.

In Russia the German Sixteenth Army has been surrounded at Staraya Russa, and the Russians are closing in on it. Originally it consisted of

CAMP DES INTERNEES BRITANNIQUES: A group of Fleet Air Arm personnel in the internment camp at Laghouat, Algeria. The photograph was sent by Sub. Lt. (A) J. M. Robertson, D.S.C., R.N.V.R., who is on the right in the bottom row.

AIR

ENEMY AIR LOSSES TO FEB. 28th.

	Over G.B.	Over Continent	Middle East	Far East
Feb. 22	0	0	0	?
" 23	0	0	0	?
" 24	1	0	0	4
" 25	0	0	0	35
" 26	0	0	0	21
" 27	0	0	3	?
" 28	1	0	1	?
	2	0	4	60

Totals: North, 5,653; Middle East over 3,5H; Far East (figures not official), about 291.

96,000 men, but its numbers have since been reduced. The Germans are making desperate attempts to get food and ammunition through to their men by air, but the Red Air Fleet is shooting down many German machines.

Parachutists' Exploit

FOR the second time in the present war British parachute troops have made a surprise raid on enemy territory. The first case was a raid in Calabria, and practically no details have been published about its objects or the degree of success which it accomplished. It is merely known that some of our troops fell into the hands of the enemy, and that Italian nerves were considerably shaken.

The raid of last week-end was quite a small affair, merely the destruction of a German radiolocation post at Bruneval, 12 miles north of Havre. The significance of it lies in the perfection of the arrangements and the way in which all three Services worked together. The part of the R.A.F. was to take the parachute troops to the right spot in the moonlight and drop them as near as possible to their objective. Only one detachment was dropped rather far away, and we have not been told whether only a single Whitley or a flight went astray. Anyway the troops, led by a young officer aged 20, soon found their way to the right spot. In the meantime fighter aircraft created diversions overhead, though the enemy were so completely surprised that they never seem to have realised what was going on. The German guards were at once overpowered, though they fought well, and British sappers destroyed the station.

No attempt was made to fly the parachute troops back. That was not part of the scheme at all. The Navy took on the final part of the show. Infantry were landed to engage the shore defences. These defences were shelled by the warships and were taken in the rear by the returning parachute troops. All our men, except for a very few casualties, were safely embarked, with their prisoners, well before the German armoured division, which was lying some 50 miles off, was able to get to the scene. The whole operation took only two hours.

RUN TO EARTH: The *Scharnhorst* and *Gneisenau* were very soon tracked down to their new lairs after their escape from much-bombed Brest, thanks to the far-ranging reconnaissance of the R.A.F. Here is their photograph of the *Gneisenau* (indicated by the arrow) in a floating dock at Kiel. The white patches are snow lying on areas devastated by air raids.

Fierce Battle Off Java

JAVA is the great prize towards the capture of which the Japanese have been working up ever since the fall of Singapore. During last week-end they made landings at three points. Their transports and escorting warships were most resolutely attacked at night by the naval and air forces of the Dutch and Americans, and confused fighting took place. There were losses of cruisers and destroyers on both sides, but at the moment of writing the concrete results have not been collated and published. The air forces of the United Nations flung themselves whole-heartedly into the fray, and bombed a large number of the Japanese transports.

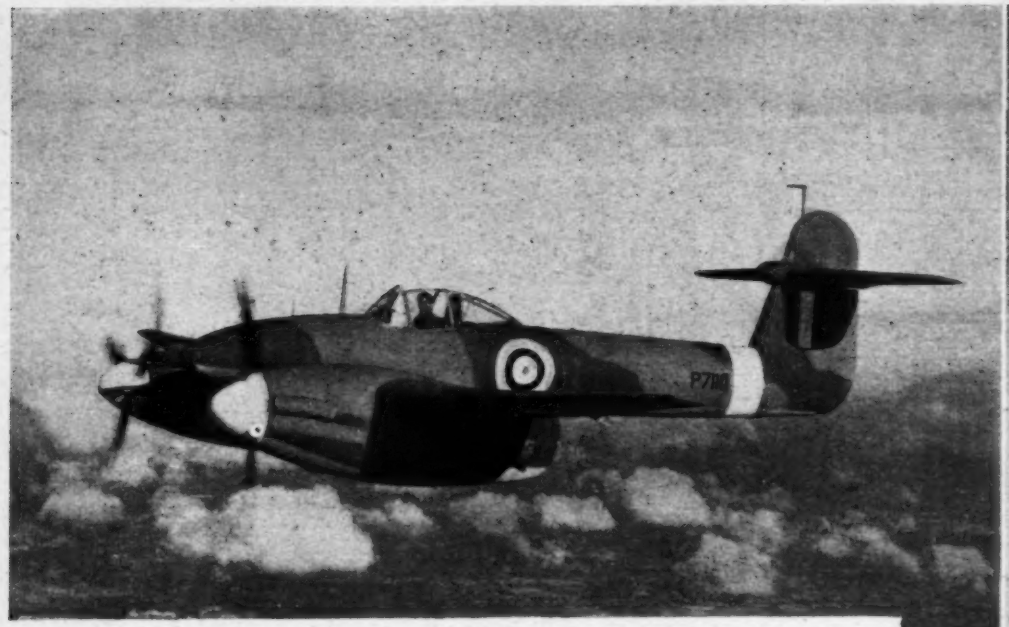
SILENT APPROACH: Twelve-seater amphibious gliders are reported to be on order for the U.S. Navy Air Service and this artist's drawing of the type appeared in a recent issue of our American contemporary, *Flying and Popular Aviation*. These gliders are said to be nearly as big as a DC-3 airliner.

BRITISH AIR LOSSES TO FEB. 28th.

	Over G.B. A'crft.	Over Continent B'brs.	Over Continent Ftrs.	Middle East A'crft.	Far East A'crft.
Feb. 22	0	0	0	0	0
" 23	0	0	0	0	0
" 24	0	3	0	4	1
" 25	0	2	0	3	2
" 26	0	3	0	2	0
" 27	0	3	1	6	0
" 28	0	0	3	2	0
	0	11	4	17	3

Totals: North, 3,285; Middle East, about 991; Far East (figures not official) 29.

THE WESTLAND WH

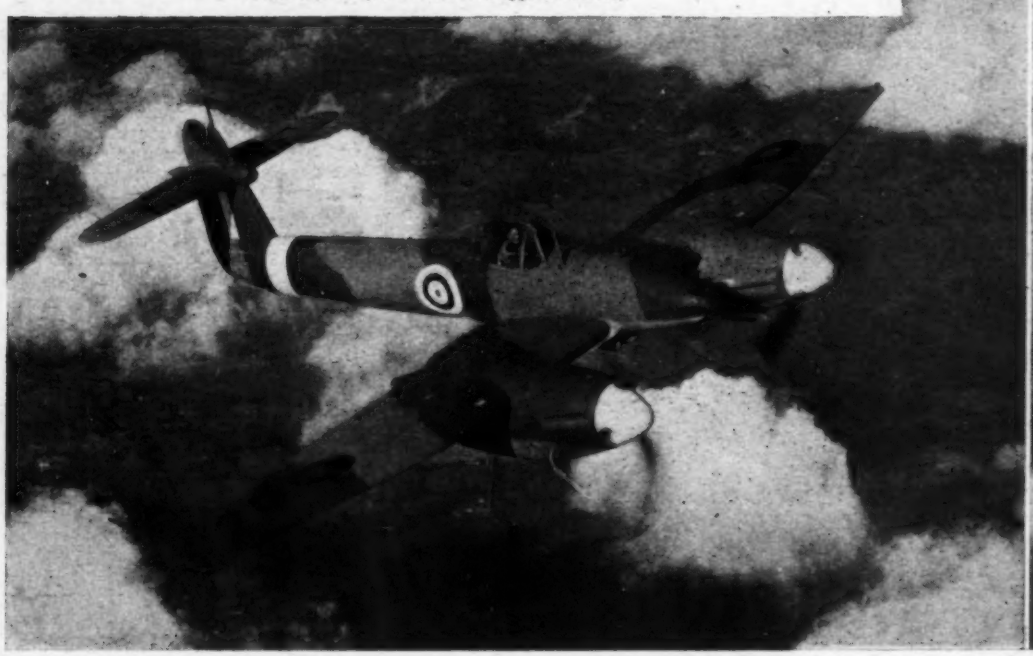


THIS superb set of air photographs of the Westland Whirlwind is the result of close collaboration between Mr. H. J. Penrose, Westland's chief test pilot, and our chief photographer, Mr. John Yoxall.

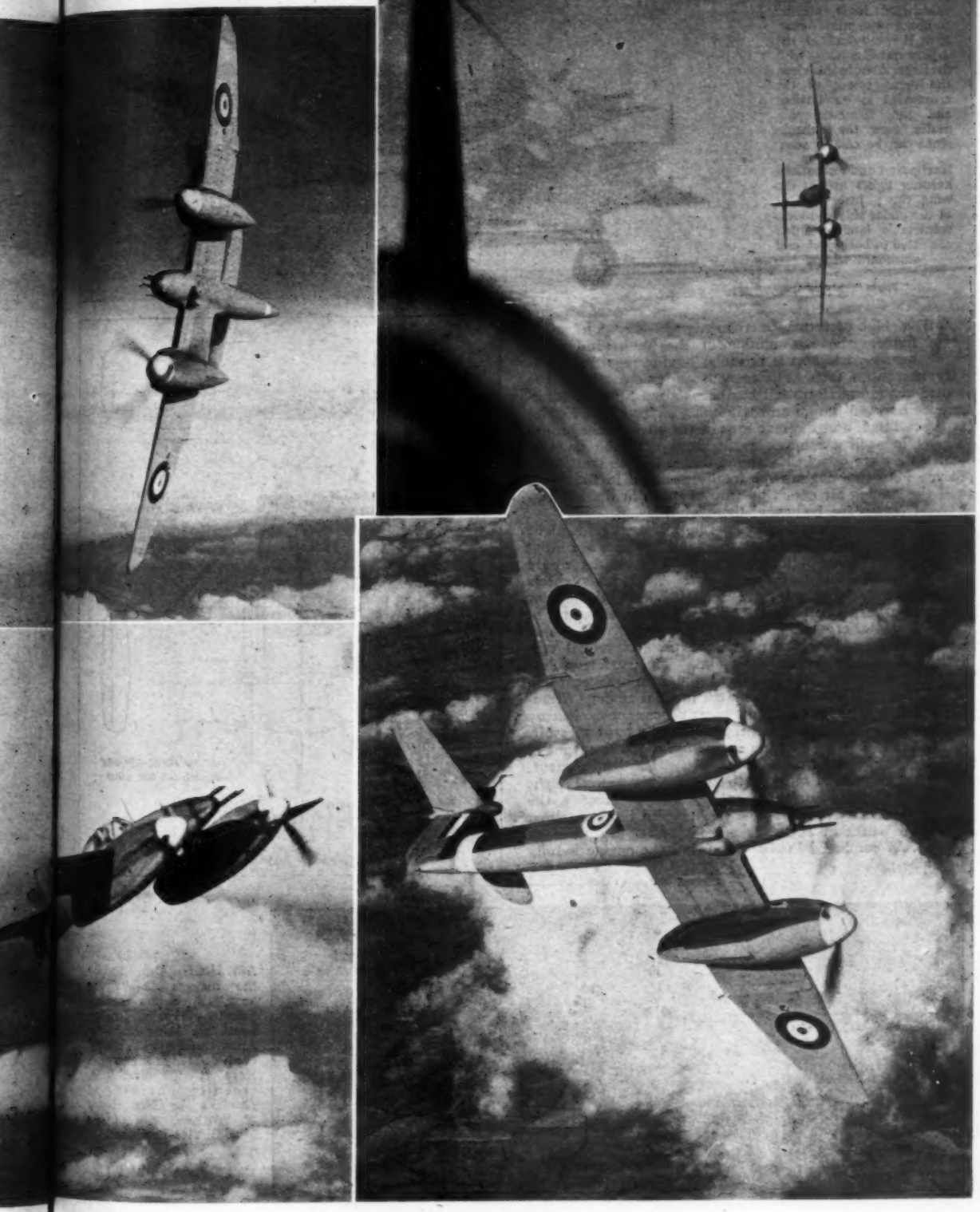
Although the machine is orthodox in layout, the high placing of the tailplane gives the Whirlwind a distinctive outline. Armed with four 20 mm. Hispano cannon in the nose and powered by two Rolls-Royce Peregrine engines, this fighter is both fast and formidable.

It is shown here from almost every angle; its amazing manœuvrability and power in the climb are vividly portrayed.

Some details of the Whirlwind appear overleaf.



VHLWIND



THE WESTLAND WHIRLWIND

With wheels and flaps down as for landing the Whirlwind loses all its compact cleanness—note how the tail end of the engine nacelles hinge with the flaps. Also, in this view, the arrangement of the armament is emphasised and the flame-damping muffs over the exhaust stubs can be clearly seen.

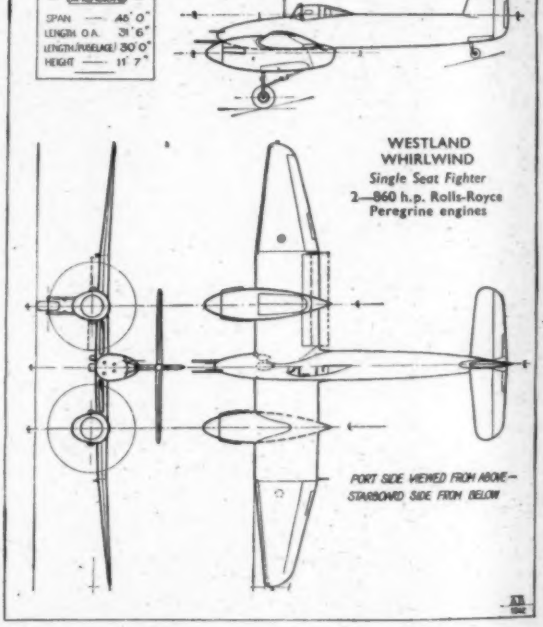
Navigation and formation-keeping lights are in the wing tips; just inboard of the under side roundels retractable landing lights are fitted to both port and starboard wings.

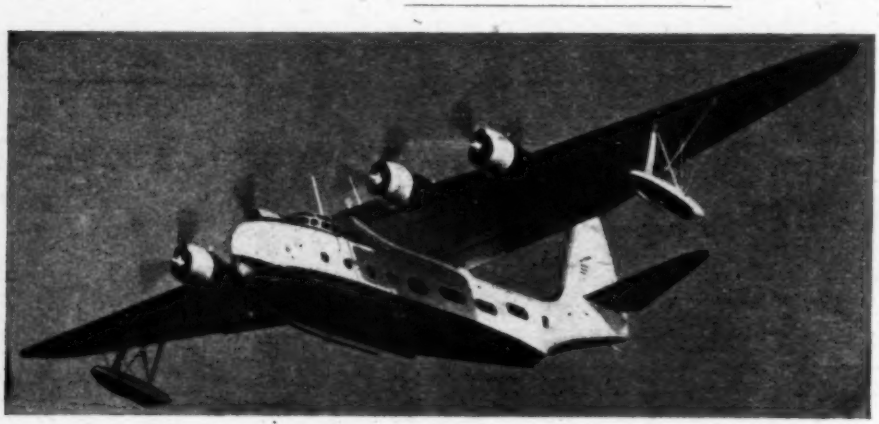
"Flight" photograph.

AS a high-performance twin-engined day and night fighter, the streamlining of the Whirlwind is as nearly perfect as is possible, having regard to military necessities such as armament and view. Even the centre of the cruciform tail has been faired to avoid interference between the fin and tailplane. Flaps of the Fowler type are fitted, and the rear ends of the engine nacelles are hinged in such a manner as to move with the flaps to which they are attached. The radiators for the two Rolls-Royce Peregrine engines are totally enclosed in the wing, and the cooling air enters by way of ducts in the leading-edges between the body and the engines.

The Whirlwind was designed as both a day and a night fighter; for night flying retractable landing lights are fitted under both wings. Muffs to damp the exhaust flames are also an essential feature for night work. All landing wheels are completely retractable, and seen "head-on" this fighter presents a very small target. The engine nacelles are, in fact, of greater cross section than the fuselage. The transparent covering over the pilot's cockpit gives equal visibility in almost every direction. The airscrews are constant-speed De Havillands of the cam-bracket type. The diameter is 10ft., and the pitch range is 20 deg. Armament consists of four 20 mm. Hispano cannons. Enemy sources give the maximum speed as 353 m.p.h. at 16,350ft.

The Rolls-Royce Peregrine engine has a power output of 885 h.p. at 3,000 r.p.m. at 3,000ft. Its displacement, 1,297 cu. in., is the same as that of the Kestrel. Weight is 1,106 lb. Following the usual Rolls-Royce practice, the Peregrine is a 12-cylinder Vee engine with liquid cooling. The two banks of cylinders are set at 60 deg. to each other. As employed in the Whirlwind the engine is fully supercharged.





ACE HIGH! Described by the makers as "flying aces," three four-engined Vought-Sikorsky flying boats are being built for American Export Airlines' trans-Atlantic service. Here is the first one, recently christened *Excalibur* by Mrs. Henry A. Wallace, wife of the U.S. Vice-President.

HERE AND THERE

Airgraphs from India

THE Postmaster General has announced that the first Airgraphs from India have now arrived in this country.

New Seaplane Trainer

TEST flights of a new Ryan seaplane trainer have recently been successfully completed at San Diego, California.

Designated the ST3-S, the new seaplane trainer is really the military Ryan PT-22 trainer of the U.S. Army Air Corps on which twin floats have replaced the normal wheel landing gear—and the PT-22 is the army version of the commercial Ryan trainer, the ST3, which was fully described in *Flight* of February 6th, 1941.

The eventual destination of the latest Ryan floatplane trainer is not disclosed, but last year a substantial number of a similar type were delivered to the N.E.I. Fleet Air Arm and are now being used in Java to train Dutch Navy pilots.

The Ryan ST3-S is an open tandem two-seater with an externally braced low wing and powered by a 160 h.p. 5-cyl. Kinner radial engine.

Yes, He Didn't!

AN interrogation officer at an R.A.F. fighter station in the north, who is an expert in Oriental languages, says that the Japanese equivalent for yes ("Hai" in English characters), like many of their words, is capable of meaning its direct opposite.

Thus, if you accuse a Jap servant of not having done some job as ordered, he will reply "Hai." By this, says the interrogation officer, he completely covers himself, for it can mean that he *has* done it, or "Yes, I have not done it."

Which may explain how the Japs managed to talk peace in Washington and raid Pearl Harbour at the same time without blushing.

Stout Effort!

A GOOD idea of the unceasing contribution made by Coastal Command to the safety of Britain's supply routes is given in a report recently made by the A.O.C., one of the Groups.

This particular Group's aircraft have flown approximately 10,000,000 miles, all over the sea, during the year. Some patrols have lasted for 20 hours or more, the record being held by a Catalina which stayed in the air on one occasion for over 27 hours.

Combats with enemy aircraft mentioned in the report include one in which an Anson (of all things!) dived on a four-engined Focke-Wulf raider and threw such a scare into its crew that, escaping by virtue of its greater speed, it promptly made off home.

This Group, incidentally, had no fewer than 16 different types of aircraft—landplanes and flying boats—in operation during the period covered by the report.

Rocky Mountain Radio

RADIO beams are in operation along the air route from Edmonton to Alaska, enabling commercial and military aircraft to fly over the route in all kinds of weather. With war raging in the Pacific, this air route has assumed great importance, especially for aircraft from the United States flying via Canada to Alaska, "behind the Rocky Mountains."

Aircraft Wood in India

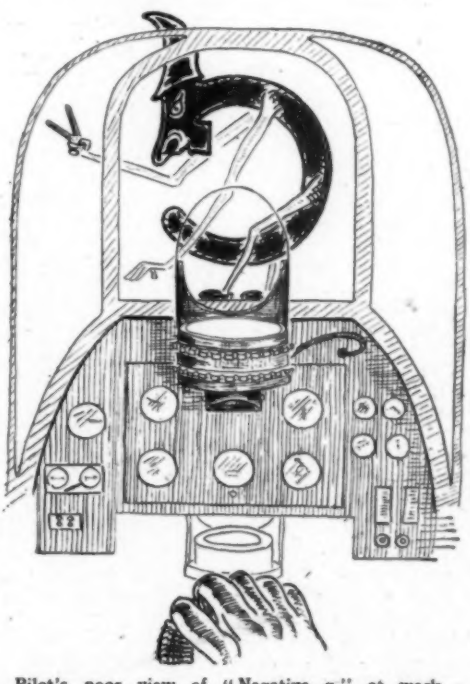
LARGE quantities of aircraft quality timber have recently been discovered in India and, thanks to modern lamination methods of building up, are being used in aircraft construction in the short lengths in which they are available. Other Indian woods, almost unknown and certainly untried until a few years ago, have since been found to have the same weight and strength as Sitka spruce.

B-19 Bomb-load

RECENT news from America of further tests with the Douglas B-19, the world's largest landplane, claim that it has now taken off with its gross weight of 140,000 lb.—the greatest weight which any aircraft has ever lifted from the ground—of which 26,000 lb. comprised dummy bombs. The balance of the disposable load was made up by fuel, military equipment and crew, and the take-off is said to have been only a few seconds longer than normal take-off time, the giant bomber being airborne after a run of 3,500ft.

This bomb-load of approximately 11½ tons represents a shade less than one-fifth of the gross weight, though when engines more powerful than the 2,000 h.p. Wright Duplex Cyclones at present fitted become available, it may well be increased as the B-19 has been stressed up to 160,000 lb. gross.

This may be compared, however, with the bomb-load of the Stirling which, for a gross weight of just over 30 tons, carries, under normal service conditions, a bomb-load of very nearly eight tons—or approximately one-quarter of its gross weight.



Pilot's poor view of "Negative g" at work. (The imp has just pushed the nose down, causing the engine to cut, and is inviting the pilot to laugh it off.)

Airline Passenger Record

AMERICAN AIRLINES claims the distinction of being the first air transport company in the world to carry a million or more passengers within the period of one calendar year.

During 1941 they transported a total of 1,202,816 fare-paying passengers, which represents an increase of 38 per cent. over the previous year's figure.

Zealous New Zealanders

NEW ZEALAND has more men serving in the R.A.F. than any other British Dominion, calculated on a population basis, according to a report in *Wings*, the official organ of the Royal New Zealand Aero Club, of a recent speech by Air Comdre. H. W. L. Saunders to the English Speaking Union in Wellington.

He explained that, before the war, New Zealand offered to train pilots for Great Britain and this had given them a flying start when the Empire Air Training Scheme was introduced. It had already embarked on a war training programme before hostilities began, and so its training organisation was able to expand to its full extent by the end of 1940.

New Job for "Punch" Dickens

C. H. "PUNCH" DICKENS, D.F.C., O.B.E., who until recently was operating manager of the R.A.F. Ferry Command in Canada, has now been appointed assistant to L. B. Unwin, Vice-President of Finance of the Canadian Pacific Railway, who has jurisdiction over the company's air services.

A pioneer of the western air mail express flights, "Punch" Dickens blazed 75,000 miles of air trails over the barren northlands in one year, and has patrolled the Rockies with the Forestry Aviation Branch. Canadian born, Mr. Dickens served in France during the last war with the R.F.C., when he won the D.F.C., and, since then, the story of his pioneering flights over the barren lands of the northern territory in connection with survey, forestry, mining, fur trading and air mails, reads like an adventure yarn in a boys' paper.

D

UNDERGROUND FACTORIES

Ensuring Night and Day Production Under All Conditions

IT will come as a surprise to many people to learn that there are underground aircraft factories in this country. Some are in actual operation, but the largest one is now nearing completion and, ere long, in the bowels of the earth, away from interference by raiders, what was once a quarry will hum with the wheels of production. The factory will employ thousands of workers on aircraft engines, just as other subterranean factories are engaged on airframe parts and important accessories.

During a recent visit, at M.A.P. invitation, to one or two of these factories we were impressed by the practicability as well as the careful planning and finish to floors, walls and ceilings, which are of light colour. The bright effect is assisted by the fluorescent lighting system adopted in works and offices. Naturally a special study of working conditions has been necessitated from the point of view of health, convenience and safety. From tests made, operatives and trade union officials have, we are told, expressed highly favourable opinions of underground working.

In the largest of the factories, air-conditioning is arranged via huge ventilator shafts, upwards and downwards, which distribute the flow of air through ducts. The air is cleansed in permutors.

The influx of workers requires special consideration, and already hostel sites are in being with modern accommodation, some of the sites including small self-contained flats for 2,000 married workers. There are shower and ordinary baths and wash basins in the living quarters.

Canteens and Lifts

Very large canteens of up-to-date design with steam heating and G.E.C. electrical equipment provide for the inner man, some of them large enough to cater for 500 operatives at a time. Several sets of passenger lifts (apart from goods escalators) akin to those of an underground station are installed which can transfer the workers down or up in quick time, and the intention is to work night shifts as soon as the machine tools have been installed.

In another smaller example, what was originally a chalk mine, has been converted into an admirable factory. Full Ministry co-operation was given to this project, and the work has been completed to schedule in a remarkably short time. The project was discussed in January, 1941, contractors commenced work in May, and component parts were produced by September of the same year. The factory is now two-thirds completed. The floor area is approximately 40,000 sq. feet, made up of various tunnels having a total length of over 1,000 feet. When the works are in full commission 600 operatives will be required. A day and night shift is worked.

To Prevent Dazzle

As in the first-mentioned factory, light throughout is by fluorescent tubes which give a pleasant illumination approaching daylight, and thus no dazzling effect is experienced when leaving the tunnels and going into the open air. Again, the atmosphere is fully conditioned and fresh or recirculated air is metered down the main trunk ducts for distribution throughout the shops. All vital departments and offices are represented in the tunnels, and thus practically complete immunity can be claimed from damage by enemy action.

An advanced type of Control Room has been adopted, revealing an up-to-the-minute picture of the many thousands of parts which are being produced daily; it is overlooked by the offices of the Progress and Planning engineers and the Managing Director.

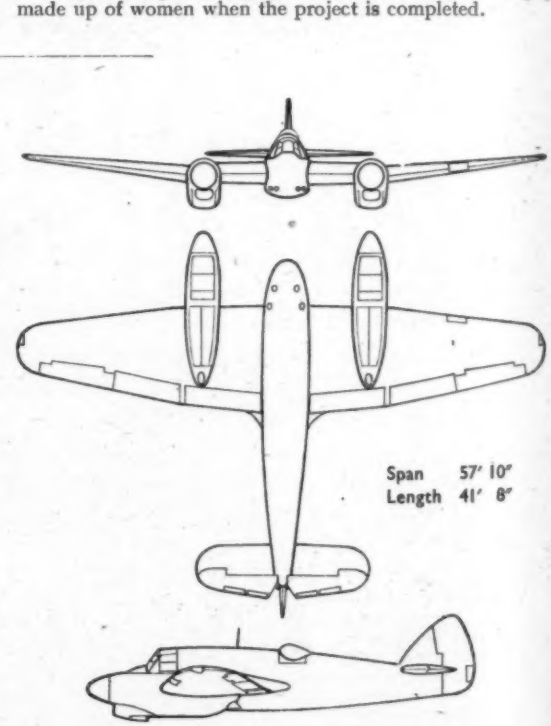
Full welfare facilities are available at this factory also, and it is anticipated that the labour force will be largely made up of women when the project is completed.

R.A.F. Return from Russia

WITH the announcement of awards to officers of No. 151 Wing, R.A.F., which has been serving in the U.S.S.R., is released the news that the Wing is no longer in Russia. By arrangement with the Soviet Government it returned some time ago, having successfully completed its mission in North Russia.

The Wing, which was composed of two squadrons, was equipped with Hurricane fighters. It was under the command of Wing Cdr. H. N. G. Ramsbottom-Isherwood, A.F.C., and was sent to North Russia for two purposes—to assist the Russian Air Force to resist a German drive against Murmansk through North Norway and Finland, and to demonstrate Hurricane fighters to Russian pilots and ground crews who had been chosen to be instructors to the units of the Russian Air Force which were to be equipped with this type of British aircraft.

On the successful completion of these tasks the Russian Air Force took over the aircraft and equipment for their own units. These aircraft have since been supplemented by large deliveries of Hurricanes which have been supplied by this country for the use of the Red Air Force.



BRISTOL BEAUFIGHTER II: Here are the general arrangement drawings of the Beaufighter II which differs from the Beaufighter I in that it has Merlin engines instead of Hercules. This exchange of radials for in-line engines has increased the overall length by less than one foot, other dimensions remaining the same.

TWO-SPEED BLOWER DRIVES

The Need for and Advantages of Two-speed Superchargers : Plate Clutches, Roller Clutches and Fluid Couplings Used

By F. M. KINCAID, Jr.

IN view of the increasing use of two-speed superchargers on military aircraft we have considered this survey of interest to British readers. The paper was presented to the National Aircraft Production Meeting of the Society of Automotive Engineers at Los Angeles, California, in October of last year, and the author is on the staff of the Wright Aeronautical Corporation.

SHORTLY after the first World War, engine manufacturers turned to the production of supercharged engines to increase the power output. Obviously the problem was to increase the quantity of air taken into the engine, as the power is directly proportional to the mass of the air charge. This increase in charge can be attained by means of a blower with a smaller engine weight increase than it can be by increasing the piston displacement. All of the early mechanical superchargers were driven by single-speed gears.

European manufacturers first concentrated on engines to develop their maximum power at high altitudes for interceptor fighters. The primary objective of American manufacturers was to develop engines with high power at "take-off" for heavily loaded transports and bombers. For this reason the ratio of blower speed to engine speed tended to be higher in European engines than in American engines.

A highly supercharged engine is a delicate thing to handle. This type of engine must be operated at part throttle at low altitudes; at full throttle the supercharger will supply more air than the engine can safely use. The higher blower compression heats the fuel and air mixture excessively, reducing the power and inducing detonation. This quickly causes the spark plugs, valves, pistons and rings to fail. At the higher altitudes the atmospheric temperature and density have declined so much that the engine can safely be operated at full throttle. European operators soon demanded more power for take-off. American operators demanded more power at altitude. American manufacturers then introduced engines with a two-speed blower, adding the high ratio to a moderately supercharged engine. European manufacturers adopted the two-speed drive, adding low ratio blower to their highly supercharged engines.

Both European and American manufacturers now furnish two-speed drives in the same range; from 6:1 to 8:1 for the low ratio for use at "take-off" and altitudes up to approximately 10,000ft.; and from 9:1 to 11:1 for maximium power at the higher altitudes. This type of supercharger will supply the maximum amount of air that can be used by the engine without the adoption of intercoolers. A curve showing the altitude gained by the second speed is given in Fig. 1.

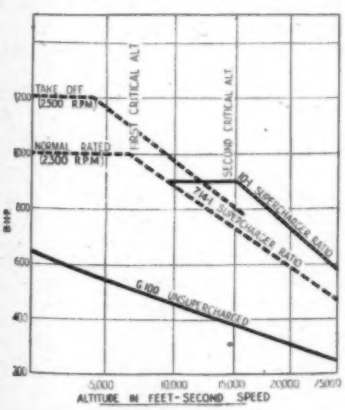


Fig. 1. Curves showing altitude gained by the second speed of a two-speed supercharger drive.

Details of a single-speed drive are illustrated in Fig. 2. This drive consists of a tailshaft gear (A), shown integral with the tailshaft, which drives an intermediate gear (B), made integral with a larger diameter intermediate gear (D). This gear (D) drives the impeller shaft gear (E). The ratio for this particular drive is 10:1, though a drive of approximately 7:1 is more commonly used.

Wright Two-speed Plate Clutch

The Wright two-speed supercharger drive is similar to this single-speed drive except that there is a hydraulically actuated friction clutch between the small intermediate gear (B) and the larger intermediate gear (D). When this clutch is engaged the impeller is driven at ten times engine speed in the high ratio. For operation of the engine in the low ratio blower, this clutch is disengaged and the two gears are coupled together by a small planetary reduction gear which is very similar in construction to the large reduction gear used for the propeller drive, except that the sun gear is designed so that it can be held stationary by a small friction clutch in the rear cover.

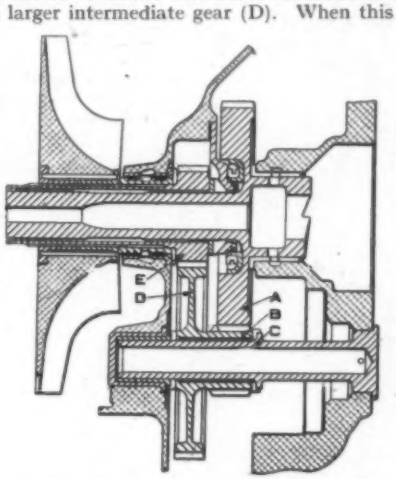


Fig. 2. Details of a typical single-speed supercharger drive. The ratio in this case is 10 : 1, which is above average.

A Planetary System

The tailshaft gear, coupled by springs to the tailshaft, drives the small intermediate gear. On the anti-propeller end of this gear is an integral internal gear. This gear drives five pinions in a small planetary reduction gear system. The pinions mesh with the sun gear, which is shown held in a stationary position by three clutch discs that are squeezed between the clutch housing and the two steel intermediate plates by a piston in a hydraulic cylinder actuated by engine oil pressure. The pinions in the reduction gear are mounted on a spider integral with the intermediate impeller shaft. As these pinions rotate about the sun gear they carry the intermediate shaft with them at a speed slower than the small intermediate gear. This shaft in turn is splined at its propeller end to the large intermediate impeller gear. This gear drives the impeller shaft at a speed lower than it would be if the multi-plate clutch within the gear itself were engaged.

When it is desired to operate the engine in the high blower ratio, the control valve on the rear cover of the engine is pulled to the rear. This cuts off the oil supply to the low-speed hydraulic cylinder and simultaneously

TWO-SPEED BLOWER DRIVES

allows the oil in this low-speed cylinder to drain out into the rear section of the engine, dropping the pressure to zero. It also uncovers ports in the valve sleeve and allows the oil supply to go through the intermediate shaft and into the hydraulic actuating cylinder housed in the high-speed gear. When oil pressure is applied in the high-speed cylinder the piston is forced to the rear and squeezes three clutch discs between the retaining plate fastened in the rear end of the gear and the two intermediate steel plates. This makes the small intermediate gear, meshing with the tailshaft, and the large intermediate gear, meshing with the impeller gear, the equivalent of one solid gear as shown in Fig. 2 for the single-speed drive.

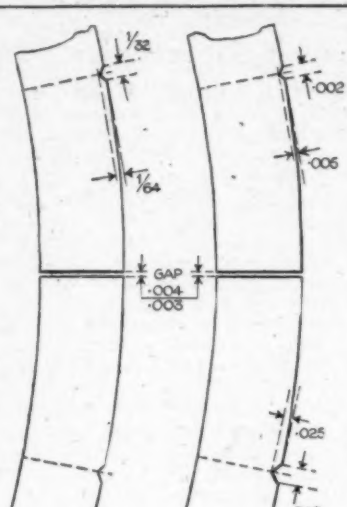


Fig. 3. High-ratio piston ring, old type, showing oil grooves. Minute variations in dimensions caused sludging trouble.

There is one important difference between the high-speed clutch and the low-speed clutch. The high-speed clutch is rotated at 2½ times engine speed when the drive is engaged in the low ratio, and at 3½ times engine speed when the drive is engaged in high ratio. The low-speed clutch housing and actuating hydraulic cylinder are stationary at all times.

Advantage of Rotating Clutch

The rotating clutch has one big advantage; the centrifugal force on the oil increases the total pressure on the piston and greatly increases the clutch capacity. It also has one big disadvantage. This was the source of considerable trouble, shortly after these clutches were introduced. The high-speed clutch cylinder acts as a centrifugal separator, separating the sludge in the engine oil from the oil. This sludge is not formed in the clutch itself. It is formed in other parts of the engine, in the combustion chamber by charring of the oil and separation of lead from the fuel, or by carbonising of the oil on the back of the pistons and other portions of the engine that run at an extremely high temperature.

These small carbon and lead particles are carried to all parts of the engine. They are extremely small and will pass through the finest filter, but when they get into the high-speed clutch-actuating cylinder and are whirled at approximately 7,000 to 8,000 r.p.m. at the higher operating speeds, these heavy particles are thrown to the outer parts of the cylinder. These particles become interlocked into a very hard mass very much like hard-packed sand on a beach.

After a very long continuous period of running in high blower, this sludge may be packed in so tightly that the spring which returns the piston of the high-speed clutch to the neutral position will not be able to force this sludge out of its path. This clutch then remains engaged when the operator shifts the control valve from high to the low position. But the low-speed clutch is entirely independent of this high-speed clutch and it becomes engaged. Two different clutches are then trying to drive the same impeller at two different speeds, and one of the clutches will fail. Invariably one clutch is left to drive the supercharger.

A very minor detail was the main cause of this trouble. This was the type of vent originally incorporated in the high-speed clutch, to allow the oil to pass out of the cylinder when the clutch was disengaged. The only way by which this oil can leave the cylinder is through an orifice at the extreme outer diameter of the cylinder. Even if the passage through the central part of the intermediate shaft were wide open the oil would not flow back out through the same passage by which it enters because of the centrifugal force tending to throw it from the centre of the cylinder to the outer diameter.

Curing Sludge Trouble

To allow this oil to pass out of the clutch, two small "V" notches placed ½in. from the gap were provided in the piston ring. These notches were intended to be open all of the time; and at all times, while operating in high ratio, there is a continuous flow of oil into the high-speed clutch and out through these notches.

This type of piston ring is shown in Fig. 3. The original drawing specified that the notches be 1/32 wide and 1/64 of an inch deep. As long as the notches were made to this size the operation was satisfactory, but a fractional dimension like this on any drawing means that the dimension may vary with a tolerance of ±0.010. That means that it was permissible to make this ring with two notches 0.022in. wide and 0.005in. deep. This was entirely too small to allow the oil to pass out of the clutch after a small amount of sludge has accumulated in the outer diameter of the cylinder. A small amount of sludge can then block off the exit through the notches and the oil remains in the cylinder.

With the oil supply to the clutch cut off, the oil pressure at the centre is zero, but progressing outward from the centre, the oil pressure increases as the radius increases, due to centrifugal force on the oil. At the periphery of the cylinder this pressure may reach approximately 175 lb. per square inch. This means that the average pressure for the whole cylinder is about 80 lb. per square inch, and this is more than sufficient to keep the high-speed clutch fully engaged.

When the control valve is shifted the low-speed clutch engages about 0.2 of a second after the oil pressure is applied to the low ratio piston. The small ring of sludge and the centrifugal oil pressure in the high ratio clutch keep it engaged, and both clutches are trying to drive the impeller simultaneously, and one of them will surely fail.

To cure this trouble, the size of the vent in the piston ring was more accurately controlled. In order to identify this new ring, the two notches spaced ½in. from the gap were removed and a single notch right at the gap was substituted, as shown in Fig. 4. This size vent will not be blocked by sludge accumulated in ordinary running. This new ring promptly eliminated almost all of the sludging trouble encountered with this supercharger drive.

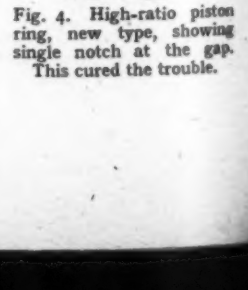


Fig. 4. High-ratio piston ring, new type, showing single notch at the gap. This cured the trouble.

A high-speed clutch gear and clutch housing was used with the equivalent of this new piston ring and operated for 477: 30 hours in an endurance test which simulated operating conditions usually encountered in actual service. This particular ring had very small notches, but it did have a 0.015in. gap. The new piston ring has a vent twice this

size. This operation left the clutch cylinder almost completely free of sludge, with only a very small ring of hard-packed sludge in the corner of the cylinder, a quantity too small to do any harm. This test was repeated with equal success with the improved ring.

Sludge will consistently collect in every rotating cavity not vented at close intervals at the periphery. Its angle of repose is from 45 deg. to 60 deg. If these characteristics are carefully noted by the engine designer, the sludge will do nothing worse than make a very "messy" and "dirty" engine after long periods of operation. If the designer does not note this behaviour he will surely be disagreeably surprised when his engine is operated for a long period.

Wright Two-speed Roller Clutch

The 7.14:1 and 10:1 ratios do not meet the requirements of all operators. Some require a combination consisting of a 7:1 ratio for "take-off" at low altitudes and a medium ratio of about 8.5:1 for "take-off" at medium altitudes. They are not interested in high power cruising at high altitudes. The Wright Aeronautical Corporation can now furnish a "close" ratio drive of 7.13:1 and 8.6:1 as well as the more normal ratios of 7.13:1 and 10:1 in a somewhat simpler and lighter-weight type of two-speed drive.

This new drive incorporates a roller clutch in the low ratio. It eliminates the rotating friction clutch in the high ratio, and in its place uses a stationary friction clutch in the rear cover in the same space as the low-speed clutch in the old plate type, and a planetary step-up gear in the space formerly occupied by the high-ratio friction clutch.

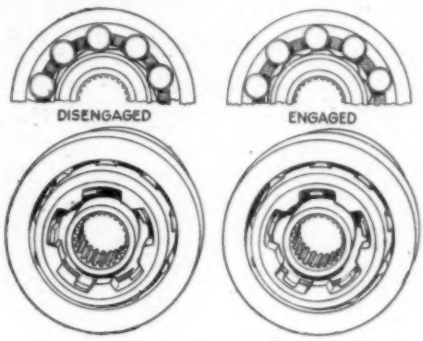


Fig. 5. The new Wright two-speed clutch uses rollers in the low-gear ratio.

In this drive, the large intermediate gear greatly resembles that in the old-type clutch. Instead of the splines and the provision for the hydraulic cylinder on the inside, it has a row of internal gear teeth for a planetary gear system. Planetary gears take the place of the old friction clutch. The intermediate shaft has on it a small sun gear for the planetary system instead of the trunnions for the reduction gear pinions in the old type. The small intermediate gear resembles that in the older drive except that it has splines on both ends. On the rear end there is splined an outer race for the roller clutch which resembles in general appearance the internal gear for the old reduction gear system. In the space formerly occupied by the reduction gear planetary pinions there is now a roller clutch cam and cage with ten rollers. The high ratio friction clutch element is almost identical to the old type low ratio clutch except that it has four clutch discs instead of three.

Fig. 5 shows the roller clutch unit in both the engaged and disengaged positions. When the cam is turned in a counterclockwise direction, the flats or small inclined planes on this cam cause the rollers to be pushed outward and become firmly wedged between the cam and the outer races, locking the two parts together. When the cam is turned in a clockwise direction the space between the outer race and the cam flats becomes greater, freeing the rollers and allowing the cam to turn. This unit is identical in principle to the automotive type of free-wheeling unit.

Fig. 6 shows this clutch assembly with the 7.134 and 10.04 ratios. When engaged in the high ratio the tailshaft gear (G) drives a small intermediate gear (F) exactly as in the old type of clutch. When the high ratio friction clutch, consisting of piston (P), friction discs (N), steel plates (O), and housing (L), is engaged, the intermediate shaft (A), with an integral sun gear, is held stationary. The planetary gear carrier (D-E), splined to the propeller end of the small intermediate gear (F), with its four pinions (B), then drives the large intermediate gear (C) at a speed of 1.4 times that of the small gear (F), with an overall ratio of 10:1.

When engaged in the low ratio, the high ratio friction clutch is released, and the reaction on the sun gear in the planetary system causes the intermediate shaft (A) to rotate faster than the small intermediate gear (F), causing the cam (J) in the roller clutch unit to wedge the ten rollers (K) between the flats on the cam and the outer race (H) of the roller clutch unit. This locks all of the rotating parts in the assembly into the equivalent of one solid compound gear, and the drive is then exactly like that of the single-speed supercharger shown in Fig. 2. The ratio in low blower is 7.134:1.

The maximum power transmitted by these drives is 125 h.p. in low ratio and 190 h.p. in high ratio, an impressive figure considering the small size of the unit, less than 6in. in diameter and weighing only 15 lb. for the complete drive.

One of the most interesting questions about a two-speed supercharger drive is the time required for engaging the clutches. The double-plate type drive requires three seconds for shifting from low to high ratio and 0.5 second for the shift from high to low. The roller-clutch type of drive will shift from low to high ratio in 0.3 second and from high to low in 0.7 second.

This time was measured by attaching a set of magneto breaker points to an extension of the supercharger drive layshaft. The impulse from the breaker unit was passed through an amplifier and recorded on 35-mm. film by a recording oscillograph. A second channel in the oscillograph was used to measure the engine speed by recording on the same film an impulse induced in the circuit by a spark plug lead.

This method of measuring speeds is especially valuable in testing a new design. It will give a precise answer to a number of important questions.

Bristol Two-speed Supercharger Drive

The Bristol two-speed drive is similar to the Wright design. An exploded view is shown in Fig. 7. It consists of three identical double-acting clutch units equally disposed about the central driving tailshaft and the con-

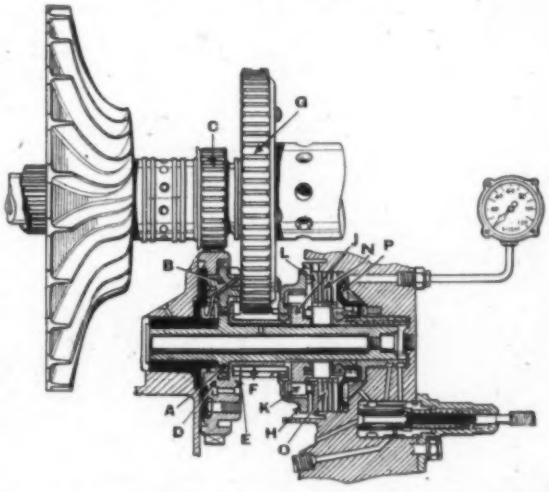


Fig. 6. The two-speed drive assembly of the Wright roller clutch.

TWO-SPEED BLOWER DRIVES

centric impeller shaft. Each unit contains two driven gears meshing with two spring-mounted driving gears on the tailshaft. Each of these driven gears can be coupled to the large intermediate driving gear by a clutch. The assembly is shown in Fig. 8. When the clutch on the gear is engaged the drive is in the low ratio, 5.27 : 1. When the clutch on the other gear is engaged the drive is in the high ratio, 7.56 : 1. The actuating oil pressure is admitted to these clutches through the hollow stationary layshaft. The double-check valve provides a means of lubricating the clutch bearings without adding a special passage for the lubricant. These clutches are prevented from engaging simultaneously by a set of interlocking pins shown in Fig. 7.

The clutches in both ratios rotate with the common housing. Two centrifuges are provided to remove the sludge from the oil before it enters the clutch-actuating cylinders. These centrifuges are driven from the lower of the three intermediate driving gears. In addition to preventing sludging of the clutches these centrifuges probably clean the complete engine-lubricating system. The centrifuges are readily removable from the rear section for cleaning at regular intervals.

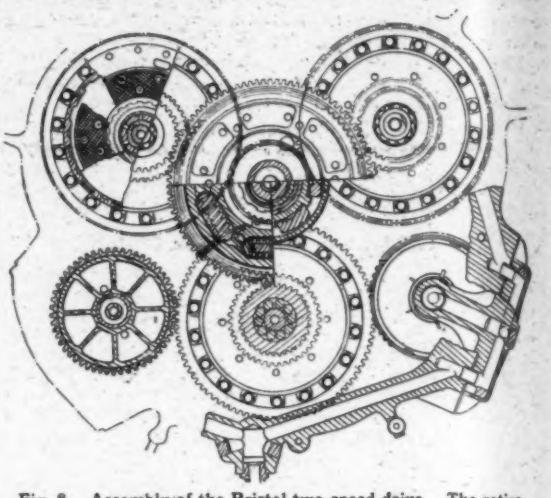


Fig. 8. Assembly of the Bristol two-speed drive. The ratios are 5.27 : 1 and 7.56 : 1.

Roll-Royce "Merlin" Supercharger Drive

The Rolls-Royce "Merlin" two-speed drive is shown in Fig. 9. This drive is furnished in ratios of 6.39 : 1 in low and 8.75 : 1 high, or 8.15 : 1 low and 9.49 : 1 high.

It has three clutch units equally disposed about the central driving gear on the shaft and the "low" and "high" gears on the impeller shaft. One of these, the upper one, is used for low ratio only, and the two lower ones are used for high ratio only. These clutches are of the semi-centrifugal type similar to those in automotive use. The actuating force is furnished by springs and centrifugal weights. The clutch is disengaged by a thrust bearing operated by forked levers. The levers are held in the disengaged position by cams. The camshaft is actuated by a hydraulic piston through a link and lever. The operating pressure for the piston is supplied by the engine scavenging pump and controlled by a valve. Except when the piston is moving from one extreme to the other, part of the scavenging oil is circulating through the cylinder, entering through a passage on the other end, and leaving through ports.

Junkers Jumo 221D Two-speed Drive

Fig. 10 is an assembly of the Junkers two-speed drive. A large bevel gear, on the crankshaft, drives the small

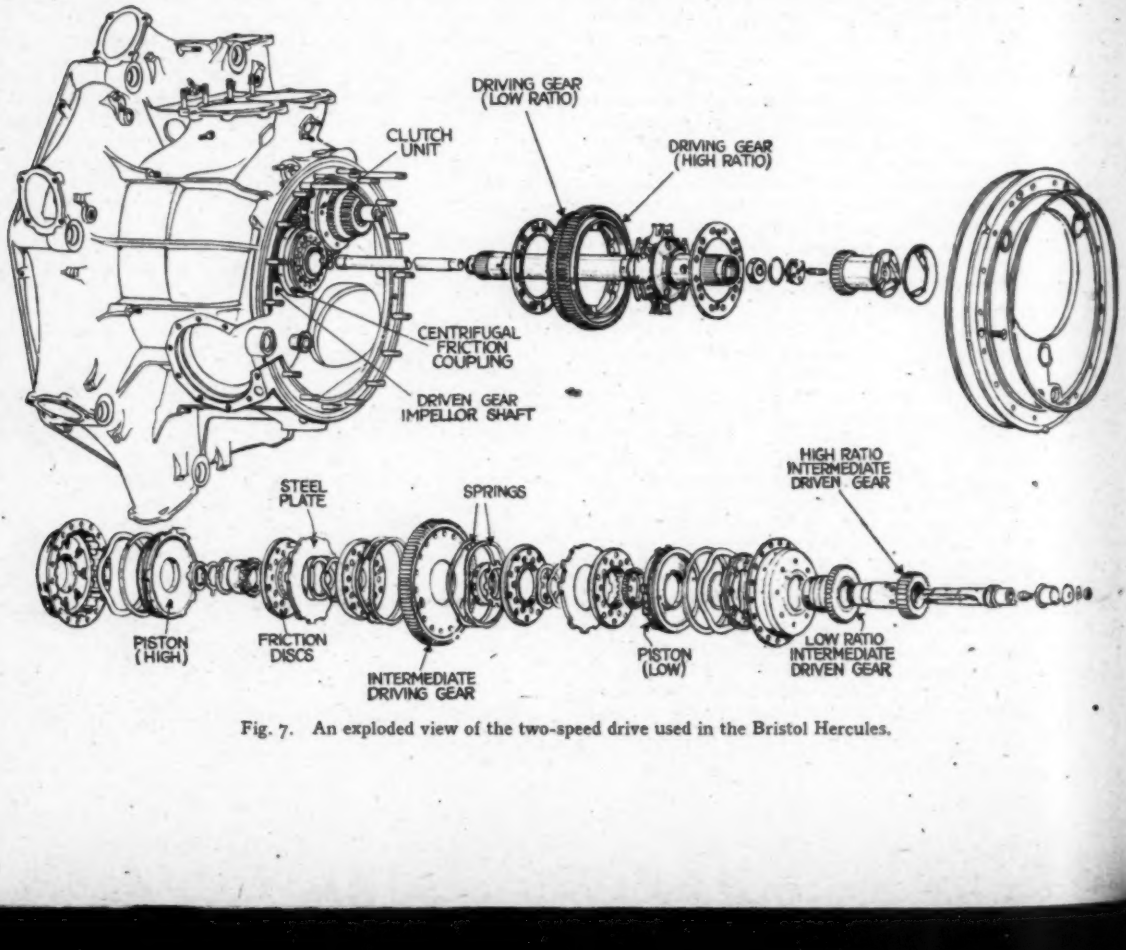


Fig. 7. An exploded view of the two-speed drive used in the Bristol Hercules.

TWO-SPEED BLOWER DRIVES

bevel on the layshaft. In the low ratio (7.95 : 1) the layshaft is connected to the 85-tooth spur gear by a roller clutch. The 85-tooth gear meshes with the 23-tooth pinion on the final drive shaft. This shaft is coupled to the impeller shaft by a centrifugal friction coupling. In the high ratio the larger intermediate gear is coupled to the driving layshaft by a friction clutch of the Ortlinghaus type, commonly used in industrial applications in Germany. The large intermediate gear drives the 17-tooth pinion at 11.375 times the engine speed.

The distinguishing feature of the Ortlinghaus clutch is the method of applying pressure to the clutch plates. A sleeve, tapered on the inside, is moved axially over three levers contacting the movable clutch plate. In this case, the axial movement of the sleeve is caused by a rotary motion of another concentric sleeve having helical splines on the outside diameter.

The control valve for the Junkers two-speed drive is shown in Fig. 11. The mechanism incorporates a barometric capsule which prevents operation in high ratio at

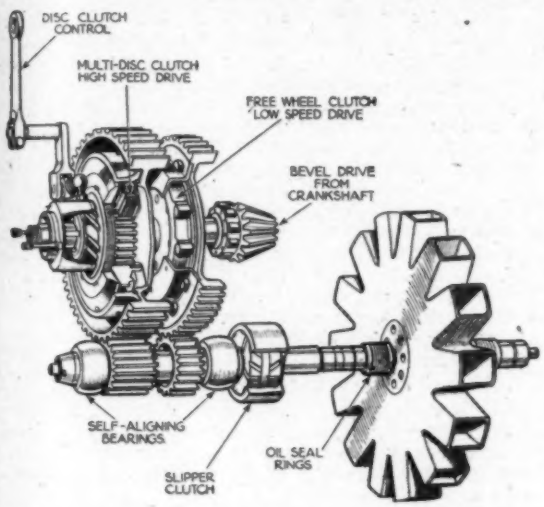


Fig. 10. Perspective view of the two-speed drive of the Junkers Jumo 211. The two ratios are 7.95 : 1 and 11.375 : 1, respectively.

altitudes below 10,000ft. The manual control valve determines the position of the spring and hydraulically operated valve. This valve supplies oil to the servo vane that actuates the two-speed shifting mechanism.

There is a constant supply of oil pressure to the central annular groove in the valve through an oil passage. This oil bleeds through the radial holes in the valve and around the spiral passage formed by the threads on the plug to the clearance space at the bottom of the cylinder. This space is drained by two valves; one is operated by the altitude capsule, and the other by the manual control valve. If either of these valves is open, the oil drains down into the crankcase, and the spring holds the valve in the low ratio position. In this position the oil pressure from one passage is valved to another passage leading to the low-ratio side of the servo vane. But if both the manual and barometrically operated valves are closed, the oil bleeding through the spiral passage builds up pressure in the cylinder, and forces the valve to the upper position. In this position the oil from the first passage is valved to the second passage and the high-ratio side of the servo vane. The manual control valve allows the oil pressure built up in the control

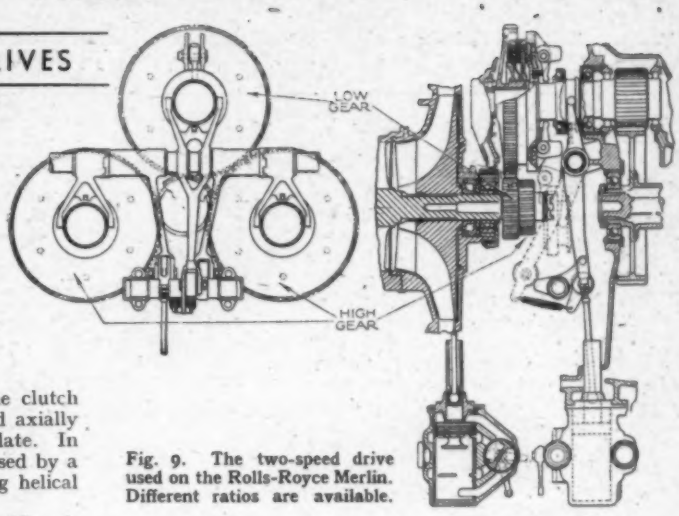


Fig. 9. The two-speed drive used on the Rolls-Royce Merlin. Different ratios are available.

valve cylinder to be applied to the layshaft bearings, augmenting their lubrication. Detents prevent hunting of the valve.

If the manual control valve is shifted to the high-ratio position at altitudes below 10,000ft., the oil in the cylinder drains out through a passage past the valve and through another passage to the crankcase, and the main valve remains in the low-ratio position.

Mercedes-Benz DB-601A Variable-speed Supercharger Drive

The Mercedes-Benz DB-601A engine utilises a fluid coupling in the supercharger impeller shaft to vary the speed of the impeller. A cross section of the fluid coupling in combination with a diagram of the complete system is given in Fig. 12. The final drive shaft (A) has splined on it the driving runner (C) of the fluid coupling. The driven member is the housing (D) and its cover (E). Two each of the die-cast parts, containing eighteen fluid cells each, are pressed into both the driving and driven members. Four of the annular rings (N) are riveted in place to provide a core about which the oil circulates. These rings are supported radially by notches in the vanes that form the walls of the fluid cells. The operating principle is identical to the fluid flywheels now being produced in the automotive field.

Even under the most favourable conditions there is some slip in the coupling. Therefore, at point (J) in the driving member the oil pressure due to centrifugal force is greater than the oil pressure at point (K) in the slower-moving driven member. Oil then flows from point (J) in the driv-

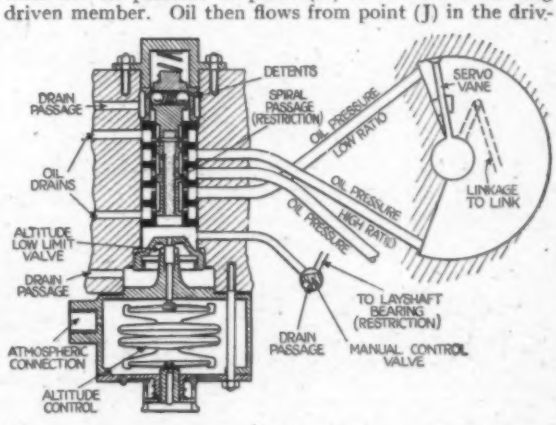


Fig. 11. Control valve of the two-speed drive of the Junkers Jumo 211D. The capsule prevents operation in high ratio below 10,000 ft.

TWO-SPEED BLOWER DRIVES

ing member to point (K) in the driven member, pushing oil at point (L) in the driven member back into the driving member at point (M), and continues to circulate about the core (N) from one member to the other. While in the driving runner the oil picks up considerable angular momentum. This energy is transferred to the driven member by the impact of the oil on the vanes of the fluid cells.

The slip of this coupling, for any given load and engine speed, is determined by the quantity and temperature of the oil in the coupling. Two pumps supply oil to the coupling. Pump (Γ) operates at full capacity at all times. At rated power and speed the coupling will drive the impeller at a ratio of about 7.3:1 with oil from this pump only. For higher ratios additional oil is supplied by the second pump (Q). A balanced plunger valve (R), actuated by an aneroid capsule (S), regulates this flow; allowing the full capacity of the pump to enter the coupling for the maximum ratio of 10.2:1 for operation at high altitude, and diminishing it for lower ratios, to zero at 7.3:1, for operation at low altitudes.

A jet (H) allows the oil to flow out of the coupling continuously, permitting the oil level, and hence the ratio, to be controlled by regulation of the rate of the oil flow into the coupling. Another important function of this flow is to cool the coupling.

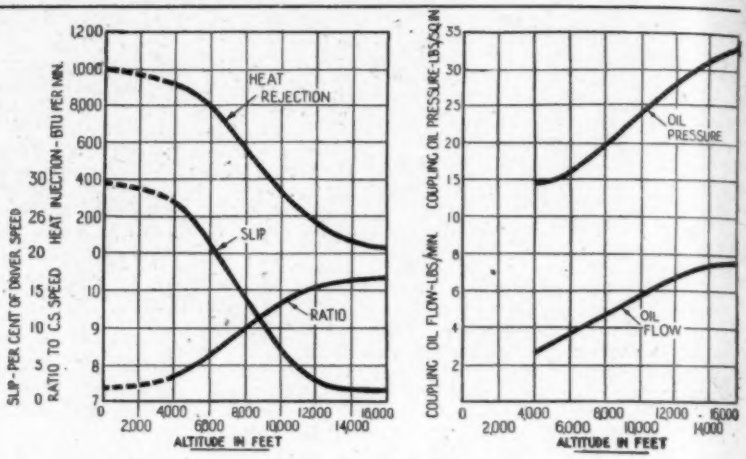


Fig. 13.—Characteristics of Mercedes-Benz hydraulic coupling. The full lines show characteristics at 2,400 engine r.p.m. and the dotted lines the performance at take-off, or 2,500 engine r.p.m.

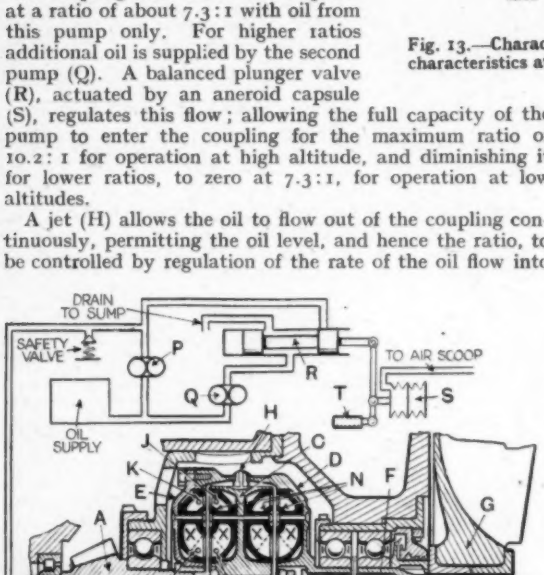


Fig. 12.—The Mercedes-Benz variable-speed supercharger drive utilises a fluid coupling in the supercharger impeller shaft.

Probably the greatest disadvantage of this drive is the large amount of heat wasted in the churning of the oil in the coupling. At "take-off" power the heat rejection to the oil approaches 1,000 B.T.U. per minute. As the slip decreases with altitude, the heat rejection diminishes rapidly to a negligible value. This would not be serious in a pursuit plane installation, as the ship would usually "take-off" with a cold engine and rapidly climb to an altitude requiring operation in the high ratio, minimum slip, condition.

However, the performance of a transport or patrol plane, flying at altitudes of 5,000ft. or less, might be seriously affected by an oil-cooler installation of sufficient capacity for an engine with this type of drive.

Conclusions

The DB-601 design has stimulated interest in this country in the fluid coupling. A great many studies will be made of it, and it is possible that it will be adapted to our requirements. Certainly, we have benefited greatly by a knowledge of its design.

With the exception of the Mercedes-Benz fluid drive, the construction of the European two-speed drives appears to be heavier than most American drives. A conspicuous example is the use of thick riveted friction faces on the clutch discs instead of the cemented facing used in this country.

The moderate altitude performance of the two-speed single-stage engine is not impressive compared with the performance required for this war. Greater emphasis is now placed on modifications of two-speed drives adapting them for use with two-stage geared superchargers with intercoolers. An increasing number of installations with the now firmly established exhaust gas-driven turbo-supercharger will also tend to decrease the interest in two-speed superchargers.

MARCH NUMBER OF "AIRCRAFT PRODUCTION"

SEVERAL articles of special interest to the industry are contained in the March issue of our associated journal, *Aircraft Production*, which is now on sale.

There is, for example, a particularly helpful article on diamond tools—the first of a series of two, written by an authority on the subject. Very little information on cutting angles and the choice of tool has hitherto been available for publication. Another article in the same specialised category deals with coolant and washing systems—an important matter in view of the high quality of surface finish demanded by the aircraft industry, while the second instalment of the article on the manufacture of the Bristol Hercules engine covers such aspects as the production of the master connecting-rod, airscrew shaft, cylinder head, and the sleeve ball and its housing.

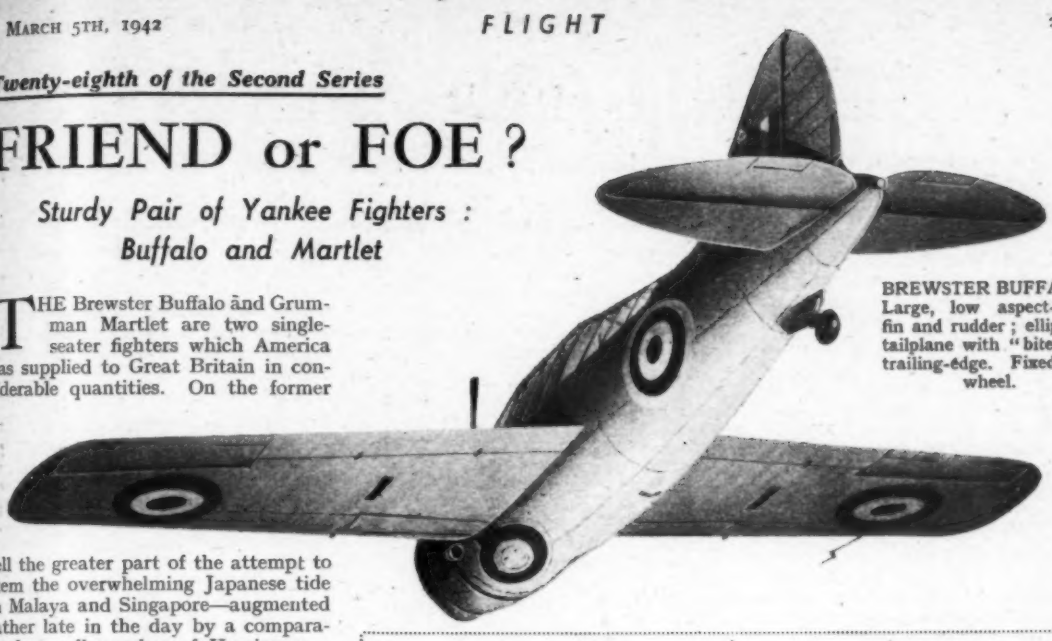
Yet another article of outstanding interest is compiled from notes from the journal, *Luftwissen*, on German spot-welding equipment.

Twenty-eighth of the Second Series

FRIEND or FOE ?

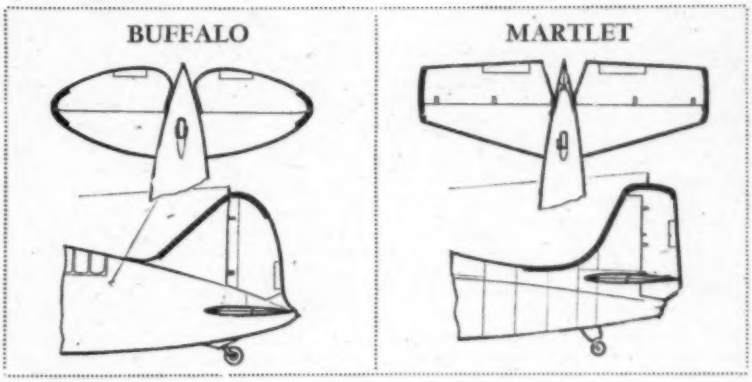
Sturdy Pair of Yankee Fighters : Buffalo and Martlet

THE Brewster Buffalo and Grumman Martlet are two single-seater fighters which America has supplied to Great Britain in considerable quantities. On the former fell the greater part of the attempt to stem the overwhelming Japanese tide in Malaya and Singapore—augmented rather late in the day by a comparatively small number of Hurricanes—but the Martlet is used exclusively by the Fleet Air Arm.



BREWSTER BUFFALO: Large, low aspect-ratio fin and rudder; elliptical tailplane with "bite" in trailing-edge. Fixed tail wheel.

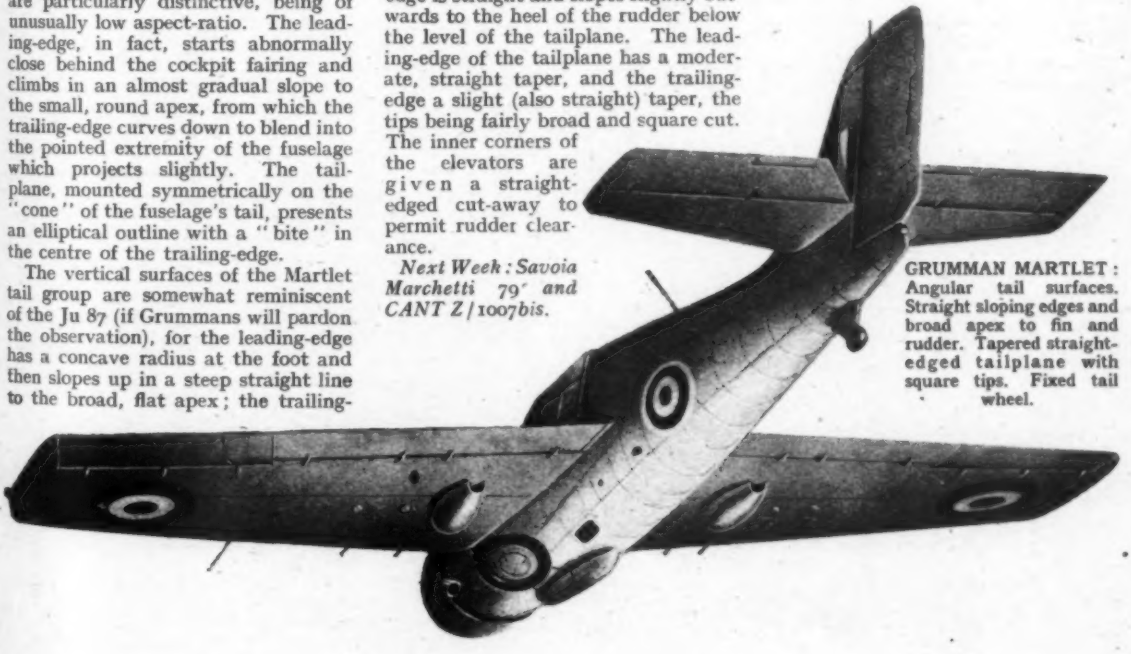
Both are excellent little aircraft, and though hardly the *dernier cri* in fighter design (particularly as regards speed and armament) they were more than welcome at a time when we badly needed every fighter on which we could lay our hands. With their radial air-cooled engines and tubby fuselages, they are very similar in general lines, but can readily be differentiated from each other by a glance at their tail units. In a word, the tail surfaces of the Buffalo present a series of graceful curves; those of the Martlet present a series of straight lines.



The fin and rudder of the Buffalo are particularly distinctive, being of unusually low aspect-ratio. The leading-edge, in fact, starts abnormally close behind the cockpit fairing and climbs in an almost gradual slope to the small, round apex, from which the trailing-edge curves down to blend into the pointed extremity of the fuselage which projects slightly. The tailplane, mounted symmetrically on the "cone" of the fuselage's tail, presents an elliptical outline with a "bite" in the centre of the trailing-edge.

The vertical surfaces of the Martlet tail group are somewhat reminiscent of the Ju 87 (if Grummans will pardon the observation), for the leading-edge has a concave radius at the foot and then slopes up in a steep straight line to the broad, flat apex; the trailing-edge is straight and slopes slightly outwards to the heel of the rudder below the level of the tailplane. The leading-edge of the tailplane has a moderate, straight taper, and the trailing-edge a slight (also straight) taper, the tips being fairly broad and square cut. The inner corners of the elevators are given a straight-edged cut-away to permit rudder clearance.

Next Week: Savoia Marchetti 79 and CANT Z/1007bis.



GRUMMAN MARTLET: Angular tail surfaces. Straight sloping edges and broad apex to fin and rudder. Tapered straight-edged tailplane with square tips. Fixed tail wheel.

BEHIND THE LINES

Service and Industrial News from the Inside of Axis and Enemy-occupied Countries

Teutonic Fitness

IT is still frequently believed that the only positive contribution of the Nazis to the German people was their care for the well-being of the younger generation. Parades of sunburnt, stripped-to-the-waist youth delighted many a visitor to pre-war Nazi Germany. But how misleading is the outward appearance is revealed by a Nazi medical periodical. There it is stated that Nazi soldiers who grew up from 1931 are inferior in medical standards and cannot stand the strain of war as well as those whose vital years of growth were in the period between 1925 and 1931. This clearly shows that in the days of the Weimar Republic the general health and nutrition level was much better than that produced by the "Strength through Joy" and "Guns for butter."

Indeed, the German medical weekly is alarmed by the growing fatigue and the reduction in physical fitness of the general populace, and suggests long periods of rest.

That such frank revelation could be overlooked by Goebbels' censors is, perhaps, in itself an indication of the growing fatigue among the Nazis.

Made in Italy

FRANTIC efforts are being made in Italy to improve the types of aircraft and engines. From the frequent visits of German experts to Italy, and other indications, it appears that there is an increased tendency to subordinate the Italian aircraft industry to German experts, to concentrate on the production of German types and on some selected engine types which have been approved by the pooled research resources.

Among such engines the following two appear to have found the approval of the German mentors:—

The *Fiat A.82RC42*, an 18-cylinder air-cooled twin-row radial. Take-off power at 2,400 r.p.m., 1,400 h.p.; in level flight and at 2,300 r.p.m., 1,090 h.p.; normal output at 2,300 r.p.m. and at 13,800ft., 1,250 h.p.; diameter, 52.7in.; length, 65.4in.; frontal area, 15.15 sq. ft.; bore, 5.8in., stroke 6.5in.; cylinder volume, 2,875 cu. in.

Reduction gear ratio, crankshaft-airscrew; 8 to 5. Crankshaft and airscrew rotate anti-clockwise. Compression ratio, 6.75 to 1; gear ratio of the single-stage centrifugal blower, 1 to 8.65; 87 octane fuel; lubricant pure castor oil. Normal oil pressure, 100 to 114 lb./sq. in. Dry weight, including accessories, 1,920 lb.

Two drives (for the revolution counters at half crankshaft speed); two universal drives (9/8 crankshaft speed); two for the synchronisation of guns (half crankshaft speed). Compressed air starter with direct fuel injection; carburettor with automatic altitude correction. Constant speed Hamilton-Fiat c.p. airscrew.

Alfa Romeo 135RC32 18-cylinder twin-row radial, an improved version with the take-off power increased by 100 h.p. Take-off power, 1,600 h.p. at 2,400 r.p.m. Rated power, 1,400 h.p. at 2,400 r.p.m. at 11,150ft. Dimensions, length 5.88ft. or 7.55ft., depending on gear; diameter, 51¾in.; frontal area, 14.65 sq. ft. Weight, dry, 2,140 lb. Bore, 5¾in. Stroke, 6 5/15in. Swept volume, 2,942in. Compression ratio, 6 to 1; airscrew reduction gear ratio, 2 to 1 (gears for both senses of rotation as well as for two oppositely rotating tandem airscrews).

Co-operation

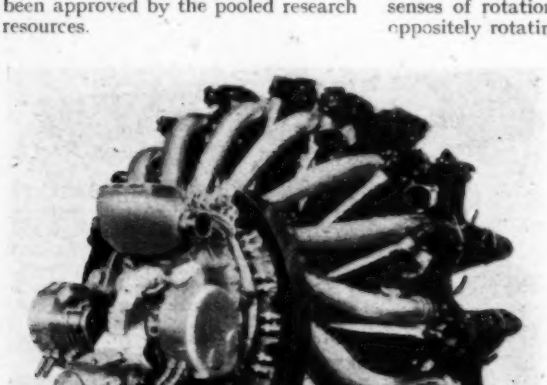
TO increase the output of aircraft in occupied France, the Nazis have "helped" to reorganise the industry. A central organisation, the "Groupement d'Organisation de l'Aeronautique" (G.O.Aè.) was established for this purpose.

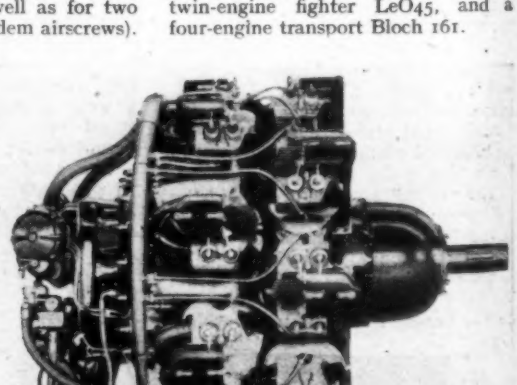
The organisation has separate divisions controlling engine, airframe and accessories production. Leading Frenchmen who are associated with the management of the institution are:—M. Henri de L'Escaille, Paul Mazere, Eugene Heral, Gaston Chausson, of the S.A. Chausson, and Pierre Latécoère.

The anxiety of the Germans to mobilise this industry for their needs is best shown by their consent to the establishment of new plants in unoccupied France. This clearly gives the Nazis the advantage of drawing on the production resources of a non-belligerent country. Quite a number of French firms have availed themselves of this opportunity to run parallel enterprises.

Thus Louis Breguet have their headquarters at Villacoublay, nr. Paris and in Toulouse; the Gnome-Rhone Engine Company has plants in Paris and at Limoges. The Hispano are producing at Bois-Colombes, nr. Paris and at Tarbes in the Pyrenees. The Potez Company continue manufacture in their old works near Albert in the occupied zone as well as in a new plant at Le Rayol, Var.

The industry, controlled by the G.O.Aè., is to concentrate on the production of the following types:—A single-seater fighter Dewoitine 520; a twin-engine fighter LeO45, and a four-engine transport Bloch 161.





(Above) The Alfa Romeo 135RC32. (Left) Fiat A.82RC42 which is installed in the Fiat B.G.A. two-engined bomber.

Correspondence

The Editor does not hold himself responsible for the views expressed by correspondents. The names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

SPINNER LOCKS

British Device to Facilitate Servicing

WE were interested in your description of the Me 109F in your issue of February 5th, in which reference was made to the ease with which the spinner on this machine could be removed in order to service the hub of the variable pitch airscrew. It might be of interest to the writer of this article that Constant Speed Airscrews, Ltd., have manufactured some thousands of spinners now in service on British aircraft, all of which incorporate this kind of lock.

Incidentally, in his description of the method of unlocking there is a slight error—only the key has to be turned to withdraw the spinner shell. Locking is achieved by a movable ring attached to the backplate engaging pins fixed to the spinner shell, and protruding through the spinner backplate.

PHILIP BURTON,
Technical Assistant,
Constant Speed Airscrews, Ltd.

THROUGH BRITISH EYES

To Prevent Misapprehensions

IN the extremely interesting article in your issue of February 5th, "Through British Eyes," on page 118, under the sub-title "Air Inflation," it is stated as follows:

"Tyres have the usual Schrader valve; Oleos an enlarged version of the Schrader with a screwed coupler."

"Schrader" is our registered trade mark and—as applied to valves—means the valves made by A. Schrader's Son, Division of Scovill Manufacturing Company.

We do not supply our valves to any enemy country. So, to speak more correctly, your contributor's reference should have been to "Valves, similar to the Schrader valve."

The Germans have copied our tyre valves and the British practice of fitting them to tyres and using the "Schrader" in a modified form for aero shock-absorbers and landing legs.

There is just a possibility that some of your readers might have misunderstood your reference, and we trust you will correct any such misapprehension.

F. H. GERRANS, Manager,
A. Schrader's Son Division.

"G" MEN OF THE AIR

Problems of "Prone" Control

I AM very greatly interested in Mr. F. C. Sheffield's article "'G' Men of the Air" I can fairly easily follow his arguments in favour of piloting high-speed aircraft in the prone position, and I will not query his statistics concerning the amount of "G" that the human frame can withstand. I have no doubt that he has made certain of his facts.

But there are two details that I should like Mr. Sheffield to explain: the first is how can the pilot in the prone position keep looking forward without straining his neck and back muscles?

Mr. Sheffield will, I am sure, realise that each swimmer who uses the breast stroke for any considerable time experiences what might well be termed a "pain in the neck." There is little difference between the swimming attitude and that of the prone position, and the weight of the head is, I believe out of all proportion to other parts of the human frame!

My second question is how will the pilot control the aircraft, particularly the rudder? I cannot quite see how his feet could "work" a rudder bar when some of his weight (even if it is only that of his legs) will be carried on the proxinal portion of the thigh.

If his rudder control had to be manual then I can hardly say I envy the pilot when, for instance, he comes in to land. He would have to go through the usual operations—undercarriage, flaps, pitch, mixture, maintain the correct gliding angle, and turn and bank.

Of course, I must surely be working on the wrong lines, but could Mr. Sheffield make it clearer for such laymen as myself? If so, we would all be very grateful; and I do feel that the two questions I have raised are going to be quite some trouble.

JOHN AMSDEN

BOMBER ARMAMENT

Are Machine Guns Inadequate?

I READ with interest details of the Short Stirling bomber in a recent issue of *Flight*, and noted with satisfaction that an attempt has been made to give armour protection to the crew.

The gross inadequacy of the armament, however, fills me with dismay. Are .303in. machine guns much use against armoured, cannon-firing fighters, especially when two are sometimes all that can be brought to bear? Is this fair to the crew, to the taxpayers, to a fine machine and the man-hours spent in constructing it?

I suggest that four 20 mm. cannon should be installed in all three turrets and that any structural alterations or strengthening required should be carried out even if it means making the bomb load seven or even six tons instead of eight.

While on the subject of armament, why was the 37 mm. cannon removed from the Airacobra and four 20 mm. cannon (or was it two and two machine guns?) installed in its place? In attack on armoured vehicles, surely the 37 mm. shell will pierce thicker armour than the 20 mm.! The arguments advanced in *Flight* last year seemed to me completely unconvincing. Followed to their logical conclusion, we should remove our 14in. guns from battleships and fit a few hundred pom-poms and machine guns! Would it not have been possible to retain the 37 mm. cannon and fit the lighter weapons in addition, each type to be used for its own special purpose?

One other point and then I have finished. The Bren-gun carrier has always seemed to me such a stupid creature running around with a pea-shooter on its back. Could not a battery of something heavier be mounted on it—say, four 20 mm. cannon in an armoured power-operated turret? It would be carrying something more proportionate to its cost, armour and size which would be useful against dive-bombers, other armoured vehicles, etc. The Bren-gun could be retained for use against infantry.

A. S. ROBERTSON.

MALAYAN FORECAST

Author's Comment on Book Reviews

IN thanking you for your very handsome review of my little book, "Bombers," may I just controvert the phrase:

"Subsequent events in Malaya, however, have proved Mr. Grey to be a singularly poor prophet."

I said that there was no prospect of the Japanese ever being able to launch so big a fleet as 500 bombers in one raid. Nothing in any report from Singapore or Rangoon indicates that raids of anything like that size have been seen. The figures that have been received for casualties at Singapore, Manila and Rangoon indicate that the raids have been very small. The biggest figures mentioned was 200 aircraft, and that was the guess of inexperienced onlookers.

Figures from Rangoon which seem reliable indicate that our fighters had no difficulty in taking on the Japanese at any odds, and that they have brought down a high percentage of raiders—30 per cent. in one raid.

We have heard a lot about dive-bombing and lack of R.A.F support, but we heard that at Dunkirk when, in fact, the R.A.F. were doing splendid work out of sight of the ground troops.

I plead guilty to the inaccurate statement that there were enormous reinforcements of aircraft at Singapore. That was made on the strength of official statements, which we are told now to regard as attempts to bluff the Japanese. That seems futile considering the Japanese population of the whole area.

No amount of air power can stop the advance of a victorious enemy army on the ground if its opponents are outmanœuvred and inadequately equipped. Malaya was lost by lack of Army troops and proper types of aircraft for Army co-operation (air observation posts and ground strafers). Our aircraft were defeated on the ground, not in the air.

C. G. GREY.

[Our reviewer's comment was provoked chiefly by Mr. Grey's *prophecy* that "there need be no anxiety about air attacks on Malaya." Events have proved there was *every* need for anxiety.—ED.]

Topics of the Day

QUITE HABITUAL

A Mixed Causerie on Constant-speed Airscrews and Human Reflexes—With a Little Feathering Thrown in

IT is, perhaps, a very mundane thing to say, but it never fails to surprise me how the extraordinary can so easily and quickly become the ordinary. Whether we are thinking of strange faces, strange ideas, or strange devices, the result is always the same; the face ceases to be strange after a week or two, the idea ceases to surprise you, and the queer device becomes a commonplace.

I well remember thinking, when the constant-speed airscrew first made its appearance, that this was an odd and even complicated affair the real usefulness of which hardly merited such complication. A two-speed or, at the most, a manually variable screw seemed to be all that was needed in any circumstances, and even when the factotums of a big airscrew factory had spent many hours drumming the advantages of the c.s. unit into my addled brain I was still rather at a loss to see what all the fuss was about.

Question of Familiarity

Nowadays I am so used to the c.s. airscrew and its effects that I take it for granted and suffer considerably on the rare occasions when I am flying some older or unmodified type with two-position or manually controlled airscrews. Earlier in this war I remember taking an old Tiger Whitley from one place to another; it was fitted with two-position airscrews, and the effect of pulling the plugs was such that I almost thought the engines had stopped. A fellow pilot, who was ferrying a second machine of the same type, actually landed it again because he thought something really *was* the matter. More recently I have flown machines which had not been completely finished and on which the revolutions have had to be manually adjusted to suit the varying conditions of take-off, climb, and level flight. The effort involved was such that I wondered how we ever managed without the little mechanisms which so effectively keep the engine revolutions at a constant and efficient figure.

Even now, there are plenty of semi-technical people on the ground who just cannot be made to see that a constant-speed airscrew really does just that—and if it doesn't, then it isn't working properly, or has the controls adjusted so that the mechanism, so to speak, has gone "over the edge" when the controls are in the take-off position. Of course, in quite a number of aircraft there is, in fact, a variation in engine speed during and after the take-off. The control, for instance, may have been set to give, say, 2,800 r.p.m. in the fully fine position, but on the run-up the engine may only give 2,600; the poor old c.s. unit is doing its very best and has wound the blades as far into the fine pitch angle as they will go in an endeavour to give the right engine speed in the very difficult circumstances of a static run. Nor is any mechanical device quite perfect, and there is inevitably some degree of lag in the operation of any c.s. airscrew—the revolutions momentarily jump when the throttle is opened, or vary a little in very bumpy air.

Not very long ago I suffered an experience which provided me with the best possible lesson in the operation of a c.s. unit. One engine of a twin failed in the air through fuel starvation. Believe it or not, it was quite half a minute before I realised that the engine actually *had* failed. My first diagnosis was that the port c.s. unit had packed up and that the airscrew had gone into its fully coarse position. The boost remained more or less right at +1 or +1½ lb. and the revolutions only dropped a couple of hundred or so. It was the increasing ache in my right leg while holding rudder (this one was not much because the good engine was at the time only giving about half its full power) which eventually told me the true story.

Now, with fixed-pitch airscrews, the port engine revolutions would have dropped off the clock and the boost would have gone right down. As it was, nobody had told the port constant-speed unit that there was no need to do any more work and it was busily trying to keep the revolutions up at the chosen figure; it did its best, and if it had had an infinite range of blade movement it would probably have succeeded. As it was, the 2,000 r.p.m. or so which it managed to maintain while windmilling was enough to keep the blower in fair action and consequently to keep the boost up. Nobody had told the blower, either, that it was merely wasting its time pushing neat air through the engine with the throttle position unchanged. I am wondering now whether, if I had opened the throttle fully, and thus reduced intake drag, both the boost and the revolutions would have been maintained.

The aching leg was an interesting thing in itself and shows how often one flies entirely by reflexes. On another occasion I flew a machine in which the rudder tab had been incorrectly adjusted. As I wasn't very interested in the performance of the machine, and was merely going from A to B in it, I didn't bother about its handling characteristics. After about a quarter of an hour of map-reading and thinking about other things, I began to feel uncomfortable; something about my body in the seat; perhaps I had a tight flying boot or I had unevenly tightened the Sutton harness. I didn't know what it was until the discomfort began to take the definite form of an ache, or a species of cramp, in my right leg. For twenty minutes I had been holding on right rudder without knowing it. I flew the rest of the way with the right wing down and my feet on the floor to rest them.

Feathering Facilities

While writing around the somewhat grisly subject of engine failure, I remember that I used to think that another airscrew refinement was by way of being an unnecessary and pansy innovation—the feathering business. Admittedly the majority of people are a little afraid of this device even now. Maybe it won't unfeather, and then where are you? Well, if an engine stops you won't be needing it again anyway, and the difference in single-engined flying with and without the airscrew feathered must be felt to be believed. And I imagine that the ability to feather an airscrew has saved the freedom and even the lives of quite a number of bomber crews. With no bomb load a twin-engined aircraft will carry along quite happily on one good engine at its cruising boost, and the only worry for the crew lies in the business of getting all the available fuel to this good engine. Quite apart from the fact that the machine can usually be held on the rudder trim alone once the airscrew has been feathered, there is less drag, less boost has to be used to maintain the same speed, and there is, consequently, a better chance of getting all the way back. I heard of one rather over-enthusiastic bomber pilot who actually flew *to* his objective with his bomb load and made several rather crabwise runs over the target, all on one engine from somewhere about the other side of the Channel. With the rest of his crew to be considered, this was not, perhaps, a very wise thing to do—but it *is* the way in which wars are won.

"INDICATOR."

TWO TRI-QUADS

The Bristol Braemar and Pullman were Triplanes with Four Liquid-cooled Engines

THE review of British four-engined aircraft types, published in our issue of February 19th, did not claim to include every four-engined machine built in this country. Indeed, in our editorial comment on the article we pointed out that only those types which might be said to have had an influence on four-engined evolution were dealt with.

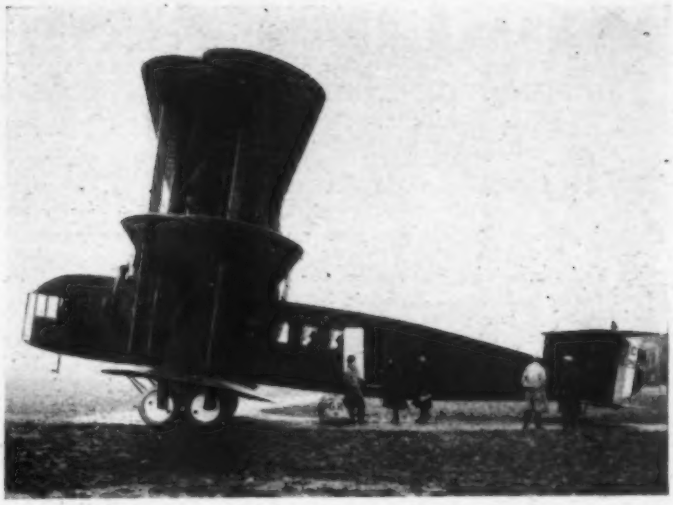
Nevertheless, two machines built by the Bristol Aeroplane Co., Ltd., might usefully be added to the series, not because they laid the foundation of later Bristol types (they were, in fact, the last triplanes built by that firm), but because they *were* the only examples of the combination of a four-engined power plant with a triplane wing structure.

There appears to be some little doubt as to which flew first, the Handley Page V/1500 or the Bristol Braemar, as the triplane bomber was called. Both were built in 1918, and our recollection is that the flight of the V/1500, in May of that year, preceded the first flight of the Braemar, but it is a little difficult to be certain after all these years.

Be that as it may, the first Braemar bomber was fitted with four Siddeley Puma engines of about 250 h.p. each. They were mounted in the middle wing, two engines driving tractor airscrews and two pushers. The top and middle wings had a span of 81ft. 8in.; the bottom wing was a little shorter, at 78ft. 3in. The total wing area reached the remarkable figure of 1,900 sq. ft. As the loaded weight was 16,200 lb., the wing loading was 8½ lb./sq. ft., and the power loading 16 lb./h.p.

With so much wing area and wing bracing, it was scarcely to be expected that the speed would be very high. In fact, it was not bad when related to the wing and power loadings: 106 m.p.h. at ground level and 93 m.p.h. at 10,000ft. The range was 700 miles at full speed (400 gallons of petrol were carried) and the ceiling 15,000ft. The military load, viz., guns, ammunition and bombs, was 2,960 lb. Defensive armament comprised a single machine gun in the nose, two guns on a turntable on top of the fuselage, aft of the wings, and a fourth gun on a ring in the fuselage floor.

An interesting feature was the four-wheeled undercarriage, which had its wheels arranged in two tandem pairs to reduce drag.



The Bristol Pullman was designed to carry 14 passengers in great comfort. Each had a Triplex window, and the cabin was heated and had electric light.

With the relatively low power of the four Siddeley Puma engines it was not thought that the performance nor the military load were quite good enough, and after the war 1914-18 a second version was produced which had four Liberty engines of about 400 h.p. each. The installation was similar to that of the Pumas, and the extra power resulted in a great improvement in performance. The top speed at ground level rose to 125 m.p.h. At 10,000ft. it was 113 m.p.h. The climb to 5,000ft. occupied five minutes, and to 10,000ft. 12 minutes. Here it may be remarked that a rate of climb of 1,000 ft./min. was almost "fighter performance" in those days.

The fitting of more powerful, and consequently heavier, engines increased the empty weight to 11,000 lb., and the loaded weight rose to 17,750 lb. This represented an increase in wing loading (the wing area remained unaltered) to 9½ lb./sq. ft. approximately, while the power loading was reduced to 11 lb./h.p.

With the end of the war the demand for heavy bombers ceased, and the Bristol Braemar did not go into production. The firm felt, however, that it would be a pity to waste all the design work that had gone into the Braemar, and a civil version, modified as to fuselage, but in all other respects similar to the Braemar, was produced. This became known as the Pullman, and was probably the most luxurious commercial aircraft of its day.

The Pullman had very comfortable seating accommodation for fourteen passengers, and the crew consisted of pilot and engineer. When carrying fuel for a flight of five hours' duration at a cruising speed of about 100 m.p.h. the pay-load was 2,700 lb., which could, of course, be either passengers or freight, or a mixture of the two. By reducing the cruising endurance to two and a half hours the pay-load was brought up to the somewhat impressive figure of 4,900 lb., or 2½ lb./h.p. The cargo space available was 320 cu. ft., and there was 7ft. headroom in the cabin.

This picture shows Braemar II, with four 400 h.p. Liberty engines. The original machine had four Siddeley Pumas of 250 h.p. each.

WORLD PRESS SUMMARY

RÉSUMÉ OF TECHNICAL ARTICLES DEALING WITH AIRCRAFT AND ASSOCIATED SUBJECTS

For the summaries and translations from aircraft and technical journals of the world, we are indebted to the Directorate of Scientific Research and Technical Development, Ministry of Aircraft Production.

"Safe" Altitudes

IF a parachutist opens his parachute immediately after leaving the aircraft at 12,000 m., his rate of descent will gradually diminish from about 13 m/sec. to 7 m/sec. as he approaches the ground. The total time of descent will be of the order of 21 minutes, an altitude of 6,000 m. being reached after about 9 minutes. When dropping freely, on the other hand, the same altitude is reached in about 1 minute, the rate of descent varying from about 100 m/sec. at 12 km. to 57 m/sec. near the ground.

It is clear, therefore, that if the parachute is opened immediately at great altitude, the parachutist is exposed to deleterious physiological effects over a considerable period of time during the drop.

These effects, at any rate as far as concerns oxygen concentration, were reproduced in a high altitude chamber on specially picked personnel. It appears that a delayed rate of descent, i.e., parachute opened immediately, was accompanied in each case with collapse of the experimental subject; grave injury and possible death could only be avoided by the immediate supply of additional oxygen. On the other hand, the physiological effects of a free drop from 12,000 to 6,000 m. were generally withstood without serious disturbance of the organism, and the author, therefore, strongly recommends that if high altitude jumps have to be carried out without special oxygen equipment carried by the parachutist, the parachute should not be opened until a "safe" altitude of the order of 5,000-6,000 m. has been reached.

This procedure is all the more to be recommended since it cuts down the time of exposure to great cold and also reduces the amount of ground drift before landing. The latter may be very important in wartime.

It is thought that with delayed opening of the chute the carrying of special oxygen equipment would be rendered unnecessary.

Of the 9 experimenters, only 3 experienced serious inconvenience when dropping freely from 12 to 6 km. All would have died if the rate of descent had been that corresponding to the open parachute.

Parachute Descent from Great Altitudes.—(H. W. Romberg, *Luftwissen.*) (Germany.)

Tip Interference

THE periodic changes of the air forces acting on an airscrew blade element that passes by the flanks of a fuselage nose are theoretically investigated. This forcing function, known to excite vibrations of airscrews and airplane structure, is harmonically analysed. The strength of the fundamental harmonic and the relative strengths of the higher harmonics are found to be greatly dependent upon the location of the airscrew plane downstream from the fuselage nose and upon the ratio of fuselage diameter to airscrew diameter.

The farther downstream the propeller is located behind the fuselage tip and the greater the fuselage diameter compared to the propeller diameter, the smaller is the intensity of the fundamental harmonic and the smaller is the relative importance of the higher harmonics of these propeller-tip excitations.

The clearance between propeller-tip and fuselage flank is found to have comparatively little beneficial effect within the usual limits at the designer's disposal.

The simplifying assumptions of this analysis restrict the validity of the results to fuselage shapes corresponding to a Rankine point-source half-body in flow of axial symmetry and propeller locations one fuselage diameter or more downstream from the fuselage bow. Experimental verifications of this analysis and an investigation of oblique flow about the fuselage are desirable.

On Propeller Tip Interference Due to the Proximity of a Fuselage.—(A. Gail and H. G. Lee, *J. Aeron. Sci.*) (U.S.A.)

Spitfire and Me 109

THE German fighter Me 109 has been designed mainly for speed and high rate of climb, whilst the British Spitfire represents a compromise, speed and rate of climb being to some extent sacrificed with the object of increasing the manœuvrability and achieving a low landing speed. Broadly speaking these differences are directly due to the smaller relative wing area of the German design, i.e., the wing loading of the Me 109 is greater than that of the Spitfire.

It is true that at very high altitudes, the induced drag becomes of increasing importance and the small-wing machine is thus handicapped. Up to 20,000 feet, however, the highly loaded Me 109 has the higher speed and rate of climb, and with this advantage its performance enables it generally to choose the instant and position of attack, with the added advantage of a possible surprise. It is true that in a dog-fight, the sharp turns of the Spitfire might prove of advantage, but there is nothing to force the German pilot to adopt such tactics for long, since his higher speed will enable him to break off the engagement at any time and renew it at will.

It must also be remembered that the main object of the fighter is to work in co-operation with the bomber. Here dog-fighting tactics necessarily lead to the escort losing touch with its bombers. The fighter with the higher speed, even if he does not shoot down his opponent, will have already achieved part of his object, since he will be the first to catch up the bomber formation. In short, speed is the characteristic of attack, manœuvrability that of defence, and in a war experience has shown that attack generally scores.

Why are the German Fighters Superior?—(*Luftwissen.*) (Germany.)

Tank Armour

THE thickness of the armour plating of the British tanks in the 1914-18 war was of the order of 15 mm. in front, 10 mm. on the side and 6 mm. on top. Modern medium tanks of 20 tons have a turret armour of about 25 mm., whilst Russian heavy tanks go to 35 mm. and super heavies (Type Klim Woroschilov) are said to possess armour up to 70 mm. thick.

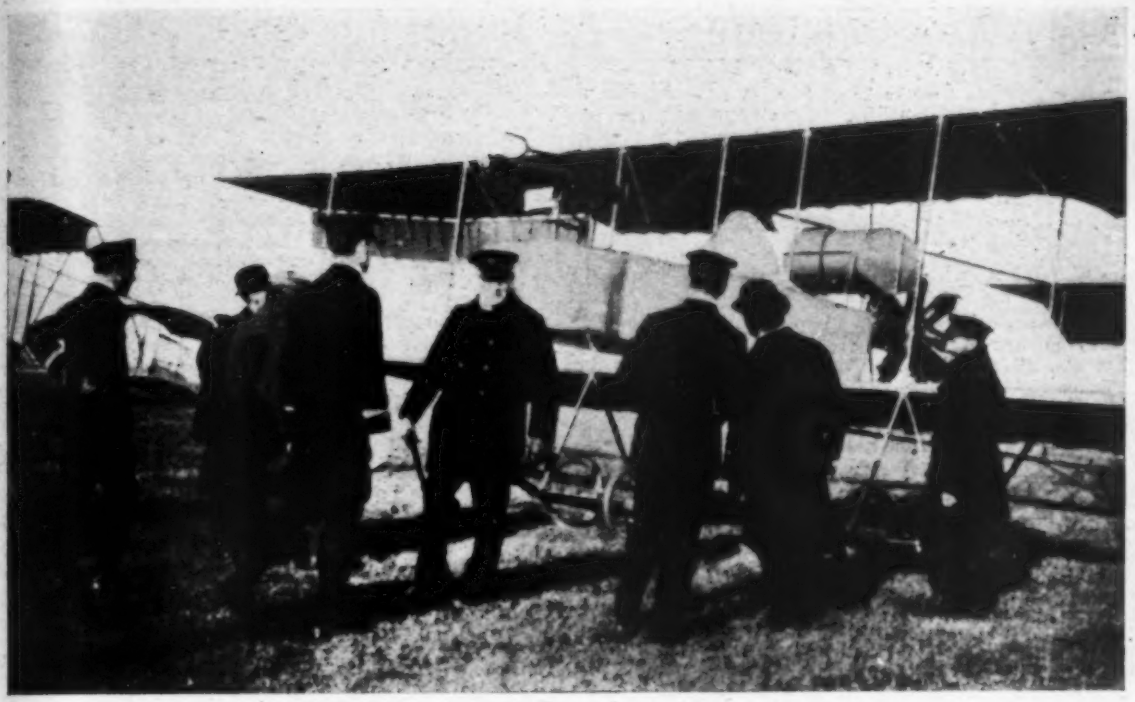
According to the author, the armour-piercing shell of a 20 mm. aircraft cannon will pierce the soft armour plate favoured by the Russians. The German tanks use hardened steel plates, which, although offering more resistance to heavy calibre shells, are stated to be more likely to crack. The Germans claim to have destroyed a considerable number of Russian medium tanks by this means, the fighter attacking from the rear at low level.

A rear attack is favoured, since the tank armour is weakest in this section due to weight of the engine, always installed at the back. Of course, tanks can also be attacked by dive bombers. In this case a near miss may incapacitate the tank by the effect of blast, jamming the gun turret or dismantling the creeper track.

The cannon attack has the advantage that the aircraft can fly over the target a number of times until its ammunition is depleted. A dive bomber after it has dropped its load must return to its base. High-level bombing attack may achieve outstanding successes, if the tanks can be surprised whilst refuelling, with the attendant danger of fire. The author is of the opinion that attacks by aircraft either with cannon or bomb are at least as effective as those carried out with special anti-tank guns, assuming that the latter are available in the positions required, and that this is reflected in the German claims of successes.

At the moment, most tanks do not incorporate anti-aircraft guns in their armament. Until this is remedied, the attack of aircraft will continue to be effective.

Aircraft Attack on Tanks, with special reference to the Russo-German War.—(T. Weber, *Flugwehr und Technik.*) (Switzerland.)



IN 1915: Mr. Winston Churchill, First Lord of the Admiralty, at Eastchurch. The machine is a Short biplane with 50 h.p. Gnome rotary engine. Note the Maxim gun mounted above the nose of the nacelle. On the right is Commander Samson, one of the early Eastchurch pilots.

Mr. CHURCHILL *and the* AIR

Aeronautical Incidents in the Life of Our Prime Minister

MANY of our older readers will probably have forgotten how closely Mr. Winston Churchill has followed the fortunes of flying since the very early days, and certainly our younger readers will have no idea of the way in which our Prime Minister has, from time to time and in many different ways, left his mark on the history of British aviation. It has seemed to us well that the connection with flying of the man who now guides the destinies of the British Empire so sternly and courageously should be more widely known, and in the following notes we have endeavoured to trace the more important points at which, in his varied career, Mr. Winston Churchill's activities have touched those of British aviation. There is little doubt that he has had a good deal more influence on its development than is generally realised.

Exactly when Mr. Churchill made his first flight as a passenger we do not know. In a leading article in *Flight* of May 20th, 1911, we said: "Within a few weeks the world has seen with its own eyes the Leader of His Majesty's Opposition and the First Lord of the Admiralty actually flying, and, what is more, taking the experience almost as a matter of course." The Leader of the Opposition at that time was Mr. A. J. Balfour; the First Lord of the Admiralty was Mr. McKenna, and the occasion was a demonstration at Hendon, arranged by the Parlia-

IN 1941: Mr. Winston Churchill, Prime Minister, alights from a De Havilland Flamingo, after an inspection flight.

Mr. CHURCHILL AND THE AIR

mentary Aerial Defence Committee in an endeavour to get the War Office and the Admiralty to take a serious interest in flying. Lord Haldane was at the War Office and Col. Seely (now Lord Mottistone) was Under-Secretary of State for War.

The actual event, so far as the flying demonstrations themselves were concerned, was not very exceptional, but the attendance was quite remarkable for those days. It included the Duke and Duchess of Connaught, Mr. Asquith, Mr. Balfour, Mr. Lloyd George, Mr. and Mrs. Churchill, Col. Seely, and some hundreds of Army and Navy officers. At that time, we believe, Mr. Churchill had not actually flown, but he was certainly beginning to take a serious interest in aviation, and this was further increased when, in October of that year, he became First Lord of the Admiralty. Commenting on the demonstration in the same leading article, *Flight* said: "To say that what took place on that historic Friday marks the apotheosis of the aeroplane from the standpoint of the British Army and Navy is a mere commonplace which the man in the street has realised for himself."

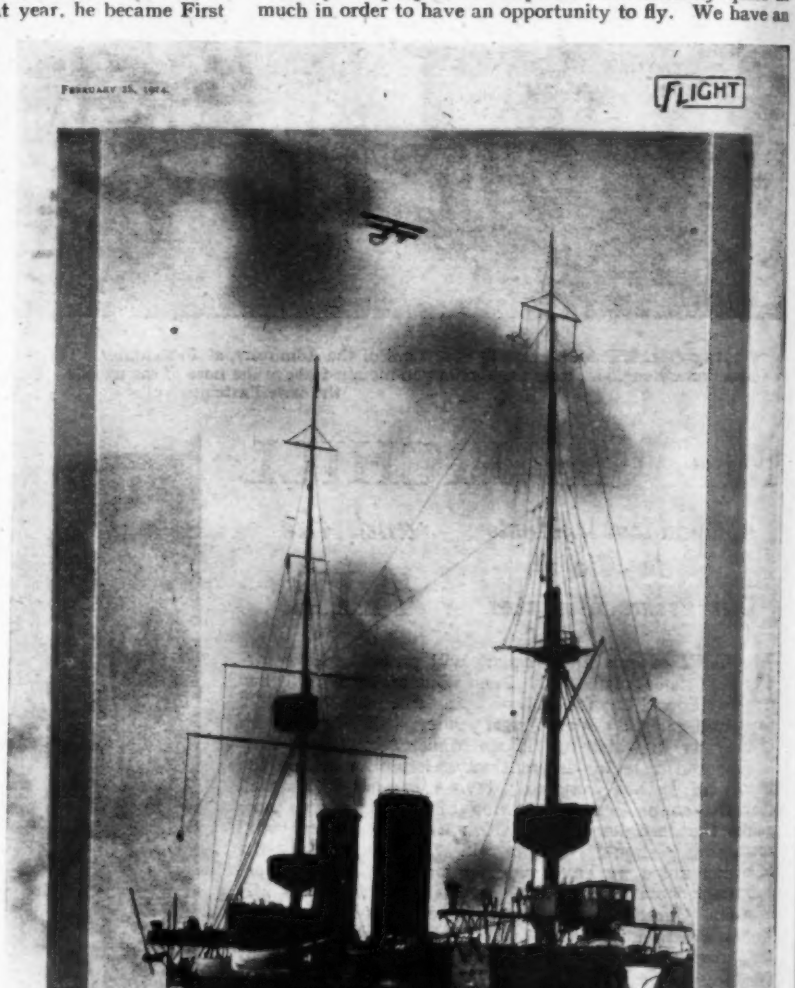
In spite of *Flight's* optimism, several years were to pass before flying really got into its stride as a military arm. That was natural in the circumstances, and by November, 1913, Mr. Churchill, at a Guildhall banquet, was able to say: "Even in the regions of the air, into which with characteristic British prudence we have moved with some tardiness, the Navy need not fear comparison with the navy of any other country. The British seaplane, although still in an empirical stage, like everything else in this sphere of warlike operations, has reached a point of progress in advance of anything done elsewhere."

The Two Wings

Here we must interpose a reminder that at that time the two sections of Britain's air arm were known as the Royal Flying Corps (Military Wing) and Royal Flying Corps (Naval Wing). How very much in earnest Mr. Churchill was about air development, even in those days, may be gathered by a further quotation from his Guildhall speech. After paying a tribute to the officers who, in a very short space of time, had raised the Naval air service to a leading position, he uttered the following warning: "But that is not enough, and I have come here to-night to tell you that it is not only in naval aeroplanes that we must have superiority. I would venture to submit to this great company that the enduring safety of this country will not be maintained by force of arms unless over the whole field of aerial development we are able to make ourselves the first nation. In order to achieve that position you will have to make up your minds to spend year after year your money, and month after month to pay toll of precious life. The keenest—aye, the surest-hand, the most undaunted heart must be offered and risked and sacrificed in order that we may attain, as we shall undoubtedly attain, that command and perfection in aerial warfare which will be an indispensable element, not only in naval strength, but in national security."

Taking Risks

Mr. Churchill was quite prepared to practise what he preached. He had been in the habit of visiting air stations, officially for purposes of inspection but actually quite as much in order to have an opportunity to fly. We have an



IN THE SMOKE OF H.M.S. "PRINCE OF WALES."—The Navy seaplane, with the First Lord of the Admiralty, Mr. Winston Churchill, on board, following the "Prince of Wales" as she is passing out of Portsmouth Harbour.

211

A 1914 MEMORY: Mr. Churchill flying over the battleship *Prince of Wales*. The word "following" in the original inscription is scarcely correct in view of the fact that the vessel is going in the opposite direction at, as the speed cone shows, slow speed ahead. The *Prince of Wales* was broken up in 1920.

MR. CHURCHILL AT EASTCHURCH IN 1913 : Capt. Wildman-Lushington, his pilot, is seen turning round to the First Lord, who piloted the machine during part of the flight. Capt. Lushington was killed a few days later.

idea that at first these little jaunts were kept secret, or at least they were not advertised from the housetops, for the First Lord of the Admiralty was well aware that objections would be raised in official quarters and elsewhere to his taking such risks.

When, however, he not only went up as a passenger but actually took control of the aircraft, the matter became front page news. Early in December, 1913, Mr. Churchill visited Eastchurch, and *Flight's* account of the event read as follows: "On Saturday the Royal Aero Club flying grounds at Eastchurch were visited by the First Lord of the Admiralty, who was accompanied by Commodore Lambert, Capt. M. Sueter, D.A.D., and Lt. Col. Sykes (Commandant of the Military Wing, R.F.C.). All the machines of the Naval Wing at Eastchurch were paraded and inspected by the First Lord, who afterwards went for two separate flights as a passenger. He then lunched at the Naval Mess, and in the afternoon made a third flight of nearly an hour's duration, during most of which time, it is understood, Mr. Churchill personally took control of the machine."

Taken to Task

Such "goings-on" were not, of course, to be tolerated, and the *Westminster Gazette* took him severely to task for his temerity. The paper said:—

> "Mr. Churchill on Saturday went for three separate aeroplane flights as a passenger, and in the third flight (lasting nearly an hour) 'it is understood' that Mr. Churchill personally took control of the machine. Col. Seely is also a Minister who has flown on more than one occasion, if we remember aright. We feel bound to say we think these Ministerial flights are thoroughly ill-advised and mischievous. They serve no sort of useful object . . . every branch of the Services ought to run its own risks, and no one can assert that it is part of a Minister's duty to do what is no doubt in itself exciting and adventurous. We hope we shall have no more of these unnecessary risks run for no sort of useful purpose."

Needless to say, the youthful First Lord took not the slightest notice, and whenever he had the opportunity he made flights as a passenger, taking control if the type of machine was one which was not too difficult to handle. A pilot with whom Mr. Churchill did a good deal of flying was Lt. Spenser Grey, and in later years, after the war 1914-18 was won, he did not forget his old friend and tutor. In 1922, for example, Mr. Churchill entered for the King's Cup air race a Blackburn Kangaroo piloted by Spenser Grey. However, we are getting rather ahead of our story.

During the autumn of 1913 and spring of 1914 Mr. Churchill paid several visits to France in order to study French aviation at first hand. One result of his visits was the placing of an order for a French airship and subsequent building of the type in this country under licence. By that time the Army had decided that it did not want airships, but the utility of the class for long-distance scouting was evident to the Admiralty, and thus lighter-than-air aviation came to be placed under the Naval Wing of the R.F.C.

Early in 1914 Mr. Churchill paid a visit to Portsmouth, and during the day he made flights in a Maurice Farman seaplane, the pilot being Lt. Longmore (now Air Chief Marshal Sir Arthur Longmore, R.A.F.). *Flight's* report of the first of these read: "A course was taken over the flotilla of submarines manœuvring in Spithead, after which a long flight was made round Portsmouth and over Whale Island before the seaplane again alighted alongside the Admiralty yacht *Enchantress*."

It was to be expected that the First Lord of the Admiralty would not escape the risks of forced landings. Engines were very unreliable in those days, and on a seaplane flight which started from the Isle of Grain in April, 1914, Mr. Churchill had his first taste of such a landing. The machine, which was piloted by Commander Seddon, R.N., developed engine trouble and was beached near Clacton. A message to the Isle of Grain brought another seaplane, which took the First Lord to his destination, Harwich. In June of the same year he made what was his longest cross-country flight up till then. In a biplane piloted by Major Gerrard he flew from the Central Flying School, Upavon, to Portsmouth, a distance of about 60 miles. That Mr. Churchill did not study the Naval air service superficially seems to be indicated by the statement in *Flight* of June 5th, 1914, that he had, previous to the Portsmouth flight, been spending several days at Upavon, during which he made many flights.

Formation of the R.N.A.S.

It was in June, 1914, that the Naval Wing of the R.F.C. was reorganised and given the new title, the Royal Naval Air Service. In commenting on the change in a leader, *Flight* said:—

> "Undoubtedly this important departure—experiment it has been called, though we dislike the word as it is applied, for the reason that we can see nothing of the really experimental about it, but rather the outcome of a well-considered judgment—springs in great part from the keen personal interest which has been manifested in flying by Mr. Churchill ever since he took office as First Lord of the Admiralty. No Minister of our time has been at so much pains to become thoroughly acquainted with the work of his department as the present head of the Navy, with the result that probably no First Lord has at any period had so deep and thorough a knowledge of the work and needs of the Navy as Mr. Churchill."

Resignation from the Admiralty

By way of protest, as *Flight* put it in a leader, "at the snarlings of the few malcontents who are ever on the alert to upset men in power," Mr. Churchill resigned from the post of First Lord of the Admiralty in November, 1915. With his subsequent adventures we are not concerned here, but he re-established contact with air matters again when, in July, 1917, he became Minister of Munitions, taking over the post from Dr. Addison. His name had been associated with certain failures (Antwerp and the Dardanelles), but it is at least debatable whether or not the blame could fairly be laid at his door. His appointment was criticised in many quarters, mainly in those opposed to him politically, but as *Flight* said in a leading article at the time: "To our way of thinking, it does not matter the proverbial row of pins whether Mr. Churchill sat on the Tory or the Radical side of the House. For all we care at the moment about his politics, he might be ultra-socialist or red republican. The only thing that matters is whether or not he is the best man available for the job. On his record we believe he is, and we congratulate the Prime Minister on

Mr. CHURCHILL AND THE AIR

having had the courage to make what is certainly not an all-round popular appointment."

During his term of office Mr. Churchill persisted in his flying. As Minister of Munitions it was necessary for him to pay many visits to France, and whenever he could he used aircraft. On one occasion he nearly came down in the Channel in a landplane, but the pilot just managed to struggle back to France. After the war he had a crash on taking off from Buc, in France. The machine was smashed, but Mr. Churchill escaped without a scratch, although he found himself hanging head-down from the cockpit of the damaged machine. Some time later he was in a machine piloted by Col. Scott. It stalled and crashed into Croydon airport. The machine was badly damaged, and the pilot was injured, but Mr. Churchill again escaped. Although suffering from shock and bruises, he took his pilot to hospital, and then went on to the House of Commons to make a speech and answer questions.

Mention has already been made of the fact that in 1922 Mr. Churchill entered a machine in the King's Cup air race. He has continued to take a very keen interest in flying, and in the years before the present war he was untiring in his efforts to stir the country and the House of Commons into a full appreciation of the German danger. His figures of German aircraft production and German air strength were not believed, and he was accused of "scaremongering." But when he became Prime Minister, Mr. Churchill refused to indulge in recriminations. We must leave it at that. To quote a phrase not entirely irrelevant, our "lips are sealed."

Mr. Churchill inspecting air crews of an Avro Manchester squadron.

BOOK REVIEWS

"Blossom the Brave Balloon." By E. F. Herbert and Philip Zee. Frederick Muller, Ltd., 2s. 6d.

HERE is a fairy story for grown-ups, told mainly in Mr. Zee's amusing sketches around which Mr. Herbert's playful text may be said to be wrapped. It's all about a balloon which broke away and caught a Jerry aircraft (presumably an Me. 109 with Spitfire wings!) by lassoing him with the end of her cable and was decorated and thereafter fed from yellow tubes instead of red and white ones.

Without doubt its specialised humour will appeal mostly to the "Ack-ack, Beer-beer" people, who will see those sly little digs inevitably lost on the outsider.

"Air Mail Magazine, 1941." A. Phillips (Air-Mail Specialist). 2s. 6d.

THE third of its kind, this is the 1941 bound volume of the monthly magazine devoted to the hobby of collecting first air-mail stamps, labels, post-marks, envelopes and special cachets. Among other functions, this magazine may be said to form a record of the progress of commercial flying, and the newcomer to its pages will be impressed by the range and variety of these history-making "first air mails," one of the most intriguing being that from Dilli, capital of Portuguese Timor, on January 18th this year, carried by British Overseas Airways.

"The Modern Diesel." Iliffe and Sons, Ltd., 5s.

THIS informative handbook, now in its sixth edition, has been produced during a period when the future cannot be predicted with any certainty and it is, therefore, necessarily limited in scope to what was observable in the general trend in the development of the diesel type engine up to the end of 1939. Nevertheless, extensive revision has gone into the preparation of the latest edition, for it has been possible to add much new and useful material notwithstanding difficulties occasioned by the war.

Beginning with a review of the original Akroyd-Stuart and Diesel patents taken out towards the end of the nineteenth century, it surveys the general development of the compression-ignition engine, the characteristics of oil engines, the intricacies of fuel-injection equipment and the problems of service and maintenance, while other chapters deal in an equally straightforward and easily understandable manner with such matters as cylinder-head design, and with the application of the C.I. engine to road, rail, marine and air transport.

It is, of course, in the last-named respect that this handbook will make special appeal to the readers of *Flight*—particularly so as it is in its application to aircraft that this type of power unit still has a vast field of development before it.

As Mr. Geoffrey Smith (managing editor) points out in his foreword, the compression-ignition engine has made such enormous headway during the past decade, mainly due to active research and experiment by road-transport manufacturers, that to-day it holds an almost unassailable position for road and railcar transport and on marine craft down to the smallest sizes.

Why the diesel engine has so far lagged behind the petrol engine for aircraft is explained in the appropriate section of the book and a number of experimental aircraft types of British, American, French and German origin are reviewed.

"I Had a Row with a German." By "R.A.F. Casualty." (Macmillan, 5s. net.)

RATHER an unusual book, this is almost a diary but not quite. It is a personal story of a Squadron Leader, starting just before the outbreak of war, and retailing his personal experiences up to the time when he was convalescent after being shot down and badly burnt. His various periods of short leave are more of personal than of public interest, and so are his thumbnail sketches of the various other officers whom he met. They gain in interest, however, by showing the author's capacity for making friends, and his wide love for his fellow men—always excepting Germans. The same remarks apply to his account of his treatment in hospital, his various operations, and his admiration for the nurses, doctors and his fellow patients. In short, this little book reveals a character which every reader must admire and of which he would like to meet the original. A brief foreword has been written by Air Vice-Marshal Leigh-Mallory, and all the royalties from the sale of the book are to go to the R.A.F. Benevolent Fund.

Service Aviation

At a Stirling dispersal point before the take-off.

Royal Air Force and Fleet Air Arm News and Announcements

Promotions

FROM the *London Gazette*, Feb. 17, 1942:—Air Comdre. A. DURSTON, A.F.C., to be Act. Air Vice-Marshal. Feb. 10th, 1942.

Air Comdre. W. H. L. SAUNDERS, C.B.E., M.C., D.F.C., M.M., to be Act. Air Vice-Marshal. Feb. 17th, 1942.

Awards

THE KING has been graciously pleased to approve the following awards in recognition of gallantry displayed in flying operations against the enemy:—

DISTINGUISHED FLYING CROSS.

Act. Flt. Lt. C. E. MARTIN, R.A.A.F., No. 57 Squadron.—On July 24, 1941, this officer was the captain of an aircraft which participated in a daylight attack on the *Gneisenau* at Brest. Flt. Lt. Martin kept in tight formation and, with his leader, presented such a determined front that the numerous enemy fighters did not dare to attack. One night last autumn, whilst flying to Berlin he failed to receive a general recall signal and went on to his target. He penetrated into the centre of the city and bombed his target. On his return to this country he made a successful landing in thick fog.

This officer has carried out 30 bombing raids (on 28 he has acted as captain of aircraft), including attacks on important enemy industrial centres and dockyard installations. He is a particularly resolute and fearless pilot who always presses home his attacks with the utmost determination, whatever the opposition or conditions of weather. He has trained his crew to a high standard of efficiency.

P/O. R. MCFARLANE, R.A.F.V.R., No. 83 Squadron.—When returning from a mine-laying sortie in the Oslo area, P/O. McFarlane bombed a small ship and set it on fire; then he returned and sprayed the deck with machine gun fire. His courage and determination have had a marked influence on his comrades.

F/O A. V. MASLEN, R.A.F.V.R., No. 451 (R.A.A.F.) Squadron.—This officer first served with a fighter squadron in England. Later he was attached to No. 451 Squadron and, since then, has carried out many operational sorties, including tactical reconnaissances. Despite intense anti-aircraft fire, P/O. Maslen has always shown complete disregard for his own safety. Although primarily trained as a fighter pilot, his reconnaissance work has been particularly meritorious, and he has spared no effort to make himself thoroughly proficient in his duties. P/O. Maslen has obtained much valuable information concerning enemy dispositions.

P/O. H. E. MAUDSLAY, R.A.F.V.R., No. 44 (Rhodesia) Squadron.—P/O. Maudslay on one occasion attacked shipping off the Friesians when the cloud base was only 800 feet, and continued his task when the cloud was down to 300 feet. He has shown an outstanding example of keenness and determination, and has been exceptionally persistent in locating and bombing his target. His efficiency as a pilot and the interest and energy he has displayed in operational efforts deserve the highest praise.

Air Marshal A. T. Harris, C.B., O.B.E., A.F.C., recently appointed C. in C. Bomber Command.

P/O. G. C. C. PALLISER, R.A.F.V.R., No. 249 Squadron.—This officer has served in England, where he destroyed at least three enemy aircraft, and in the Middle East where he has carried out many missions including sweeps, long range patrols and escorts to bomber aircraft, both by day and at night, during which he has assisted in the destruction of two enemy aircraft. P/O. Palliser has at all times shown skill and determination.

P/O. D. R. TAYLOR, R.A.F.V.R., No. 44 (Rhodesia) Squadron.—P/O. Taylor's high standard of navigation, often in extremely adverse weather, has been largely responsible for the success of so many of his sorties. He is a keen and efficient officer, whose exceptional coolness over the target has set a good example to his crew and to the squadron as a whole. He has participated in nine raids on Cologne.

Act. Flt. Lt. D. W. CHISHOLM, R.A.F.V.R., No. 106 Squadron.—This officer has performed consistently good work both in the air and on the ground. He has taken part in a number of sorties over enemy territory, including a daylight raid over occupied France. His work as a squadron gunnery leader has been outstanding, and has had a beneficial effect on the air gunners in his charge.

Act. Flt. Lt. J. W. GEE, R.A.F.V.R., No. 99 Squadron.—This officer has carried out many sorties, including attacks on Cologne, Dusseldorf, Brest, Berlin and numerous other important enemy targets. He has at all times displayed the utmost determination, regardless of enemy opposition or adverse weather circumstances. His excellent qualities, both as a captain and leader, have set a fine example.

Act. Flt. Lt. E. L. HAYWARD, R.A.F.V.R., No. 106 Squadron.—This officer is a pilot of exceptional ability, and he has performed his operational tasks with a high degree of efficiency. Flt. Lt. Hayward carried out his first six flights in the role of navigator, and he has since completed numerous sorties as captain of aircraft, successfully bombing many important and heavily defended targets and placing mines in enemy waters.

SERVICE AVIATION

On two occasions he has flown considerable distances with only one engine functioning. In December, 1941, Flt. Lt. Hayward carried out a daring daylight attack on an oil refinery at Emmerich, scoring direct hits from only 300 feet. He has always shown great courage and determination.

Act. Flt. Lt. A. S. M. PIM, R.A.F.V.R., No. 408 (R.C.A.F.) Squadron.—This officer has participated in attacks on Bremen, Mannheim, Hamburg, Duisburg and other important targets. On every occasion Flt. Lt. Pim has endeavoured to press home his attacks with great determination, in spite of heavy defences. Recently he attacked an enemy tanker from a height of about 20 feet. Despite heavy opposition from the defences, he succeeded in scoring a direct hit on the ship. Flt. Lt. Pim has performed excellent work and has set a fine example.

F/O. J. H. J. SAUVAGE, No. 44 (Rhodesia) Squadron.—This officer has participated in many sorties against important targets in enemy country. He has always shown the greatest determination to reach and bomb his allotted target. On one occasion, in July, 1941, F/O. Sauvage attacked an airdrome in France, scoring direct hits on hangars from 800 feet.

In August, 1941, when flying to Cologne, his aircraft was attacked by an enemy fighter whilst held in the searchlights. Although his aircraft sustained such damage that it became difficult to control, F/O. Sauvage skilfully flew back to base, where he made a safe landing. In September, 1941, he carried out a successful attack on Berlin. This officer has at all times set a fine example.

Act. F/O. J. B. AUSTIN, R.A.F.V.R., No. 138 Squadron.—P/O. Austin has completed many operations, and has displayed a high degree of skill in completing his tasks successfully.

P/O. N. H. ATKINS, No. 138 Squadron.—This officer has carried out many operational missions. His ability and perseverance as an observer have been outstanding, especially in operations calling for an exceptionally high standard of navigation under difficult circumstances. He has displayed great devotion to duty, and has contributed materially to the success of the operations in which he has participated.

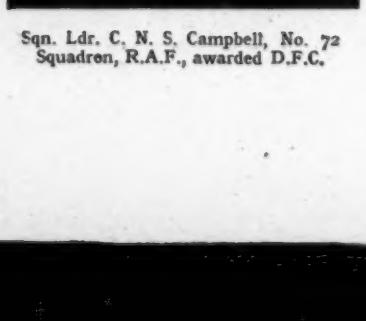
P/O. H. D. R. L. CAMPBELL, R.A.F.V.R., No. 408 (R.C.A.F.) Squadron.—This officer has shown great courage and persistence in attacking heavily defended targets in enemy territory. In September, 1941, he participated in three daylight raids over France. On each occasion his aircraft sustained damage from the enemy's fire, but, despite this, he carried out his mission successfully. P/O. Campbell has consistently shown a high standard of keenness and devotion to duty.

P/O. R. J. HARDY, R.A.F.V.R., No. 106 Squadron.—As captain of aircraft, this officer has carried out a number of sorties, including attacks on important industrial centres and dockyards. He has performed excellent work, being consistently successful in completing his allotted task. On his first sortie, P/O. Hardy shot down an enemy aircraft which attempted to attack.

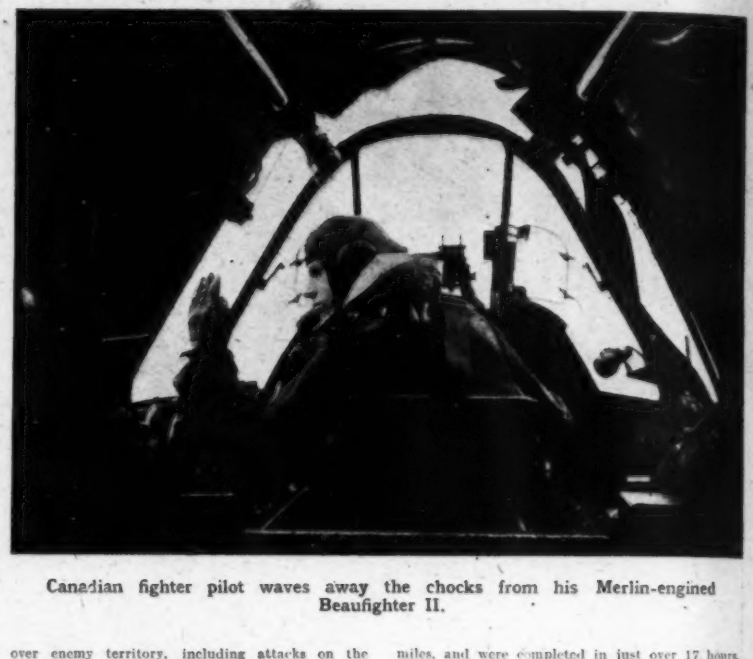
One night in October he was detailed to attack the airdrome at Schipol, and, despite exceptionally unfavourable weather, he succeeded in locating his objective, which he bombed from a height of only 700 feet. This officer has displayed great steadiness and reliability, and has not once failed to complete a mission.

P/O. P. W. HELMORE, R.A.F.V.R., No. 50 Squadron.—Both as navigator and captain of aircraft, this officer has carried out numerous sorties over enemy territory, including attacks on the majority of the main enemy targets. One night in September, 1941, he was captain of an aircraft which attacked Frankfurt. Although subjected to intense anti-aircraft fire, a most successful attack was delivered.

During the operation his aircraft was hit by shellfire, which holed the port engine oil tank. This eventually caused the port engine to fail completely, and, when still short of the English coast, the airscrew fell off. P/O. Helmore eventually made a safe landing with the undercarriage retracted, when all attempts to lower it had failed through unsuspected damage. He has at all times shown the greatest determination.



Sqn. Ldr. C. N. S. Campbell, No. 72 Squadron, R.A.F., awarded D.F.C.



Canadian fighter pilot waves away the chocks from his Merlin-engined Beaufighter II.

P/O. W. A. NEWENHAM, R.N.Z.A.F., No. 405 (R.C.A.F.) Squadron.—As an air observer this officer has displayed exceptional keenness and enthusiasm during his operational tour. He has participated in attacks on targets which have included Cologne, Berlin, Kiel, Hamburg and Stettin. Although many of the sorties in which he has taken part have been of a difficult and hazardous nature, P/O. Newenham showed himself to be a capable and reliable observer.

P/O. A. L. ROBERTS, R.A.F.V.R., No. 9 Squadron.—One night in September, 1941, this officer was captain of an aircraft which carried out a raid on Genoa. The target was successfully bombed, resulting in a large fire.

Two nights later, a successful attack was carried out at Stettin. These two operational flights, covering a distance of over 2,700 miles, involved a flying time of 17 hours. P/O. Roberts has participated in attacks as far afield as Turin, Genoa, Stettin and Berlin. He has at all times displayed great skill, perseverance and courage.

P/O. T. E. SALAZAR, R.A.F.V.R., No. 44 (Rhodesia) Squadron.—This officer, as captain of aircraft, has carried out a number of sorties over enemy territory. He has always endeavoured to press home his attacks from a low altitude despite enemy opposition. In July, 1941, he attacked Duisburg in bad weather.

A few days later he carried out a successful attack on Wilhelmshaven, and then bombed a ship in the haven from a low level. In November and December, 1941, P/O. Salazar carried out raids on Cologne, Dusseldorf and Aachen from low altitudes. Throughout he has shown great skill and courage.

P/O. H. L. TARBITTON, R.A.F.V.R., No. 9 Squadron.—Since deceased. This officer was the navigator/bomb-aimer of an aircraft which participated in a raid on Berlin one night in September, 1941. In the face of heavy anti-aircraft fire and searchlight activity he bombed the target area, causing two large fires, which burned fiercely.

He has participated in attacks on most of the principal targets in Germany, and throughout he has displayed exceptional coolness in the face of the enemy. His skill and devotion to duty have done much to inspire confidence in the crews with whom he has flown.

P/O. C. D. WADDINGHAM, No. 9 Squadron.—One night in September, 1941, this officer was the navigator/bomb-aimer of an aircraft which carried out an attack on a target at Genoa. Bombs were released over the objective, and a large fire was started. Two nights later P/O. Waddingham participated in a raid on Stettin. A most successful attack ensued.

These two operations covered a distance of 2,700 miles, and were completed in just over 17 hours. The success achieved can largely be attributed to P/O. Waddingham's accurate navigation. This officer has completed many sorties, including attacks on enemy industrial centres and ports. He has at all times shown great determination to reach and bomb his allotted target.

P/O. B. H. WILLIAMS, R.A.F.V.R., No. 103 Squadron.—This officer has carried out a number of sorties as captain of aircraft or as second pilot. These missions included attacks on Mannheim, Berlin, Frankfurt, Turin and other important enemy targets. Throughout, P/O. Williams has always endeavoured to press home his attacks to the utmost. One occasion, when acting as captain of aircraft, P/O. Williams spent considerable time looking for his target, in spite of much physical suffering through intense cold and lack of oxygen. Although the aircraft compass had become unserviceable, he flew his aircraft safely back to this country after a flight of over eight hours.

On another night, after bombing and photographing his target in spite of light anti-aircraft opposition, P/O. Williams made a second run over the target expressly to obtain other photographs in case those sought at the first attempt had failed. This officer has consistently shown a high degree of skill and courage.

P/O. W. G. J. WOODMASON, No. 218 Squadron.—This officer participated in the squadron's operational activities in France and afterwards when it operated from this country. He has shown himself to be an outstanding navigator-bomb aimer, whose efficiency, devotion to duty and coolness in action have enabled his crew to carry out highly successful raids on long-distance targets such as Berlin, Stettin and Turin in difficult weather conditions.

On one occasion, whilst attacking Duisburg, one engine of his aircraft was put out of action by enemy shellfire. Nevertheless, his captain jettisoned all movable gear and kept the aircraft flying, and P/O. Woodmason skilfully navigated it back to base, where a safe landing was made.

Lt. H. M. ELLIS, R.N., No. 826 Squadron.—This officer has performed excellent work as a flight commander. He has at all times displayed initiative and determination and has led the formation with outstanding success. One evening in January, 1942, Lt. Ellis carried out a difficult operation against an enemy convoy. In spite of strong enemy air and anti-aircraft opposition, he succeeded in torpedoing and sinking his objective. He afterwards flew his damaged aircraft safely to base.

DISTINGUISHED FLYING MEDAL

Sgt. W. H. ELLIS, No. 83 Squadron.—This airman has participated in attacks on Brest, Bremen, Kiel, Knapsack and many other heavily defended targets. As wireless operator, his work has been of the highest order. On two occasions he has attacked shipping with machine-gun fire. One night in November, 1941, he expended most of his ammunition when attacking an enemy airdrome from a height of only 100 feet. Apart from his work in the air, Sgt. Ellis has done much to uphold the morale and improve the ability of other operators.

Sgt. D. V. FLAVELL, R.A.F.V.R., No. 77 Squadron.—This airman has participated in many attacks against targets in enemy territory, including sorties against Brest, La Pallice, Bremen, Hamburg and numerous other well-defended targets. He has shown himself to be an exception-

ably able wireless operator, and on several occasions has contributed materially to the safe return of his aircraft in difficult weather conditions. Sgt. Flavell's efficiency has inspired confidence in the crews with whom he has flown.

Sgt. A. JONES, No. 149 Squadron.—One night in August, 1941, this air-gunner participated in an attack on Brest. On the return journey his aircraft was twice attacked by enemy fighters. In the first engagement the enemy's fire killed the front gunner and put the turret hydraulics out of action. Sgt. Jones continued to operate the turret manually and the attacker was driven off.

In the second engagement Sgt. Jones beat off the attacker and probably destroyed it. On reaching this country a crash landing was made owing to shortage of petrol, and Sgt. Jones got safely out of the wreckage, summoned assistance and extricated the wireless operator and second pilot. He has at all times shown great courage and devotion to duty.

Sgt. A. LYNCH, No. 144 Squadron.—This wireless operator-air gunner has participated in attacks on dockyards, industrial targets and other important enemy targets. His work, both in the air and on the ground, has been of a high standard and has contributed materially to the successes achieved. One night in November, 1941, he participated in a low level attack on a large and heavily escorted convoy off the Friesian Isles. The ship selected for attack was heavily bombed in the face of heavy opposition. Sgt. Lynch has shown courage throughout.

Sgt. J. MOSSOP, No. 49 Squadron.—This airman has taken part in numerous sorties both as air gunner and as wireless operator. Throughout he has displayed great skill and efficiency. In December, 1941, he participated in a daylight raid on an enemy airdrome. During a low level attack on hangars, Sgt. Mossop maintained damaging fire and several Me 109's were destroyed on the ground. His aircraft was repeatedly hit by enemy fire, the navigator being killed and at least two cannon-shells penetrating close to the wireless operator's cockpit. During the return journey Sgt. Mossop carried out his wireless duties so efficiently that his captain was able to reach this country.

Sgt. S. A. E. MUNNS, R.A.F.V.R., No. 77 Squadron.—This airman has shown himself to be a consistently skilful and keen navigator. He has participated in numerous operations over enemy territory, including targets on important industrial centres and ports. Throughout, he has displayed great tenacity in his efforts to achieve success.

Sgt. K. F. NEALE, R.C.A.F., No. 144 Squadron.—This airman has participated in many sorties, as air observer, and his work has been of a very high standard. The majority of his flights have been made in adverse weather, but, throughout he has shown great skill and played a good part in the successes obtained. One night in November, Sgt. Neale was the observer of an aircraft which carried out a low flying attack on a heavily escorted convoy. The largest ship in the convoy was bombed and sunk.

Sgt. B. O. PETRIDES, No. 50 Squadron.—This airman has displayed outstanding ability as wireless operator-air gunner throughout the many sorties in which he has participated. One night in September, 1941, Sgt. Petrides machine-gunned trucks and wagons in a railway siding and set two of them on fire. On another occasion in November, he used his guns with such good effect that he extinguished six searchlights. This airman has not had a wireless failure in any operation on which he has been engaged. He has shown great keenness and set a fine example.

Sgt. L. POWRIE, No. 144 Squadron.—Throughout the heavy operational sorties in which he has participated as wireless operator-air gunner, this airman has displayed courage and a high standard of efficiency. One night in November, 1941, he participated in a low level attack on a large and heavily escorted convoy off the Friesian Isles. The largest ship of the convoy was bombed and sunk. Sgt. Powrie has taken part in raids against most of the important enemy targets, including Wilhelmshaven, Frankfurt, Kiel, Mannheim, Bremen.

Sgt. J. C. PRICE, No. 49 Squadron.—This airman has participated in sorties over enemy territory, including attacks on Berlin, Magdeburg, Frankfurt, Lorient, and many other important centres. Many instances of good reporting of bomb burst and map reading in his pilot's reports, indicate that Sgt. Price has given valuable aid to his navigator. In December, 1941, he participated in a daylight raid on an enemy airdrome. The objective was attacked from a height of 100 feet, in the face of intense opposition from the ground.

Sgt. Price used his guns with telling effect and several enemy aircraft were left burning on the ground. His own aircraft sustained much damage as a result of the enemy's cannon-fire, but, immediately his captain had flown clear of the area Sgt. Price went forward to assist the navigator, who was mortally wounded, put out the flames from his burning clothing and rendered first-aid throughout the return journey. Although involved in several unpleasant experiences, Sgt. Price has always shown high efficiency and devotion to duty.

Commendations

THE following have been commended for brave conduct during services to the R.A.F. in France in June, 1940:—

Mrs. OLIVE MARIE SHERRINGTON, Section Leader (now a Commandant), Mechanised Transport Corps, and Miss ELIZABETH STUCKLEY, driver, Mechanised Transport Corps.

Roll of Honour

Air Ministry Communique No. 113.

THE Air Ministry regrets to announce the following casualties on various dates. The next-of-kin have been informed. Casualties reported "in action" are due to flying operations against the enemy; "on active service" includes ground casualties due to enemy action, non-operational flying casualties, fatal accidents and natural deaths.

Royal Air Force

KILLED IN ACTION.—Sgt. S. R. Bottomley; Sgt. M. F. J. Boulton; Sgt. J. Handley; Sgt. E. L. Harvey; Sgt. E. P. Jackson; Sgt. J. Richmond, D.F.M.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—P/O. S. C. Braybrooks; Sgt. M. McK. Burns; Flt. Sgt. A. J. Davie; Sgt. J. W. T. Davies; Flt. Sgt. T. C. Davies, D.F.M., Sgt. R. Dunn; Flt. Sgt. R. W. J. Green, D.F.M.; Sgt. L. Hancock; A/C.1 K. F. Hannett; Sgt. R. N. Hares; Sgt. R. J. Hollobone; Act. Wing Cdr. R. G. Hurst; Sgt. P. Ingham; Sgt. W. H. Mounser; Act. Flt. Lt. T. D. I. Robison; Sqn. Ldr. J. Vivian; Sgt. W. L. Waite; P/O. E. M. Watts.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—P/O. W. Baser; Sgt. L. Beaumont; Sgt. R. J. Bennett; Sgt. J. C. E. Black; Flt. Sgt. G. E. Bolam; Sgt. S. H. Broyd; Flt. Lt. N. W. Burnett; P/O. L. S. Clayton; Sgt. W. Connell; Sgt. J. T. Corbett; Sgt. G. A. D. Cotton; Sqn. Ldr. E. Culverwell; Sgt. A. W. Dean; Sgt. H. W. Easton; Wing Cdr. G. B. A. Esmie, D.F.C.; P/O. J. D. Forrest; P/O. T. R. Fyles; P/O. C. E. Greville-Heygate, D.F.C.; Flt. Lt. W. A. Harris; Sgt. G. Houghton; Flt. Sgt. L. R. Hutson; P/O. R. F. Johnson; Sgt. H. Jones; Flt. Lt. D. D. A. Kelly; Sgt. B. Kirkham; Sgt. W. J. S. McGregor; Flt. Sgt. S. F. Marais; Sqn. Ldr. A. C. Martin; F/O. K. J. Masters; P/O. F. J. Needham; P/O. V. E. G. Phillips; Sgt. R. M. Ramsden; P/O. R. R. Reynolds; Sgt. W. J. P. Rice; P/O. A. W. Robson; Flt. Sgt. R. A. Ross; Sgt. K. L. Rowley; Sgt. E. Shackleton; Sgt. J. L. Smith; Sgt. A. J. Stiddard; Sgt. A. A. Sutton; Sgt. C. E. Triggs; P/O. G. Troup; F/O. W. Wright.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW REPORTED KILLED IN ACTION.—Sgt. M. W. G. Fox; L.A/C. F. W. Lea.

WOUNDED OR INJURED IN ACTION.—Sgt. D. C. Lowes.

MISSING, BELIEVED KILLED IN ACTION.—Sgt. J. D. Anderson; P/O. E. G. Baker; Sgt. W. A. Blackburn; Sgt. M. Gill; Sgt. J. R. Griffiths; Sgt. P. W. Hewitt; Sgt. S. Johnson; Sgt. R. Mackenzie; Sgt. G. H. Newton; Sgt. B. N. B. Orr; P/O. G. K. K. K. Pelmore; Sgt. W. J. Poulton; W/O. T. Purdy; Sgt. T. Rogers; Sgt. P. C. Williams; Sgt. J. W. Woodroffe.

MISSING.—Sgt. R. F. Aldous; P/O. S. Beckett; Sgt. J. F. Bente; Sgt. T. F. Burn; Sgt. J. Cardwell; Sgt. L. A. Churcher; P/O. P. T. Close; Sgt. N. Coatesworth; Sgt. E. F. J. Cooper; Sgt. G. H. N. Davey; Sgt. D. S. Edmond; Flt. Sgt. R. Exelby; P/O. E. W. M. Garstin; P/O. T. F. B. Geary; Sgt. G. A. Glanville; Sgt. G. L. Gregory; Sgt. A. J. Gulliver; F/O. G. W. Haigh; Sgt. K. E. Hall; P/O. D. A. Halsall; Sgt. A. L. Hanes; Sgt. R. C. Hawkes; Flt. Lt. G. G. Heathcote; Sgt. J. G. Henderson; Sgt. E. Hudspith; Sgt. G. H. Hunt; P/O. T. F. Jacobs; Sgt. A. M. Johnstone; Sgt. N. Kaby; P/O. T. L. Kaschula; Sgt. D. R. Kelly; Sgt. D. M. Kingston; P/O. P. N. Kingwill; F/O. F. Martin; Sgt. B. A. Mobberley; Flt. Lt. K. H. Nash; Flt. Sgt. G. G. Noseley; Act. Flt. Lt. B. Parnell; Sgt. D. G. Penman; Flt. Sgt. J. Peters; Sgt. W. L. Pointing; Act. Flt. Lt. T. F. Priest; Sgt. J. H. M. Pulford; Sgt. O. E. Rance; Sgt. W. D. Reason; Sgt. A. J. Reid; Sgt. W. B. Robertson; P/O. W. G. Scarlett; Sgt. F. H. Silk; P/O. C. L. Smith, D.F.M.; Sgt. C. S. Stephens; Sgt. E. Upton; Sgt. E. Wade; Sgt. J. Warren; Sgt. R. Wheatle; Sgt. H. Whittaker; Flt. Sgt. G. C. Williams; Sgt. L. J. Woolley; Sgt. T. P. Wright.

MISSING, BELIEVED KILLED ON ACTIVE SERVICE.—Sgt. E. G. Forster; Sgt. W. T. Higgs; Sgt. B. Jepson.

KILLED ON ACTIVE SERVICE.—Sgt. I. R. Beldan; Sgt. R. D. Bower; L.A/C. J. K. Briers; Sgt. R. H. Chivers; F/O. S. D. J. Dalgleish; Act. Sqn. Ldr. C. E. Elliott; Sgt. A. Gibbons; Sgt. E. T. Griffith; A/C.1 I. Hackett; A/C.2 N. Jones; Sgt. F. Lambert; Sgt. P. D. Lambert; Sgt. J. W. Leadill; Cpl. D. McNeilly; L.A/C. F. F. Morgan; A/C.1 H. L. Norton; Sgt. C. H. Page; Sgt. S. E. Reeves; Flt. Lt. E. J. A. Williams, D.F.C.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED ON ACTIVE SERVICE.—L.A/C. F. W. Thorpe.

P/O. R. Lewis who was able to protect Sqn. Ldr. Finucane on the way back to base after the squadron leader had been wounded.

Scene in a pilots' room at a fighter station while the pilots were out on business.

SERVICE AVIATION

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED ON ACTIVE SERVICE, NOW REPORTED KILLED ON ACTIVE SERVICE.—A/C.1 R. E. G. Cockburn.

WOUNDED OR INJURED ON ACTIVE SERVICE.—L.A/C. W. T. Birch; Grp. Capt. D. G. Boddie; A/C.1 W. J. Letton; Flt. Lt. A. B. Mobley; P/O. L. A. Parr; Sgt. D. F. Ruchwaldy; Sgt. D. S. D. Welch.

DIED OF WOUNDS OR INJURIES RECEIVED ON ACTIVE SERVICE.—L.A/C. P. D. Campbell; Act. Flt. Lt. L. Wood, M.B.E.

DIED ON ACTIVE SERVICE.—Act. Flt. Lt. A. Darling; A/C.1 H. A. Glover; A/C.1 J. T. Hoare; Cpl. B. F. Holder; Sgt. G. R. Hullneck; Cpl. F. L. Jones; A/C.2 I. M. Kendall; A/C.2 R. B. Lamble; A/C.2 A. E. New; Cpl. J. W. W. Paul.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW REPORTED PRISONER OF WAR.—F/O. G. C. Conran.

Women's Auxiliary Air Force

DIED ON ACTIVE SERVICE.—A/CW.2 E. J. O'Toole; Cpl. M. J. Skinner; A/CW.2 A. M. Wilkinson.

Royal Australian Air Force

KILLED IN ACTION.—Flt. Lt. R. G. Arnold; F/O. A. R. Baster; Sgt. T. L. Brown; F/O. J. M. G. Hood; Sgt. J. McNeil; Sgt. G. F. Perry; Sgt. P. H. Smith; Sgt. D. G. Taylor; Sgt. R. K. Wilson.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—P/O. G. L. Wells.

WOUNDED OR INJURED IN ACTION.—F/O. G. T. Chinahen; Sgt. H. R. Garland; Sgt. I. T. Higlett; Sgt. C. F. McWilliam.

MISSING, BELIEVED KILLED IN ACTION.—Sgt. R. R. Oelrich; Act. F/O. R. C. Scarlett.

MISSING.—P/O. R. H. Browne; P/O. E. Crompton; P/O. J. W. Roche; Sgt. M. A. Sullivan.

KILLED ON ACTIVE SERVICE.—Sgt. L. E. Bull; Sgt. C. Dunstone; Sgt. A. W. J. Hunter; Sgt. J. Skinner; Sgt. J. Thompson.

Royal Canadian Air Force

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Sgt. D. M. Hughes.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Sgt. K. J. Barton.

MISSING, BELIEVED KILLED IN ACTION.—Sgt. R. D. Killin; P/O. W. A. Tanner; Sgt. R. B. Vose.

MISSING.—P/O. T. L. Bennett; Sgt. W. F. Bodkin; Sgt. M. R. Chabot; P/O. N. F. Durban; Sgt. W. I. Fairley; P/O. A. L. Fraser; Sgt. D. L. Henderson; P/O. D. M. Jenkinson; P/O. R. J. McLachlan; Sgt. W. H. O'Neill.

KILLED ON ACTIVE SERVICE.—Sgt. N. W. Barbeau; P/O. O. Crump; Sgt. S. P. Kurck; Sgt. A. B. McKie; Sgt. H. V. Payne; Sgt. E. D. Parrish; Sgt. W. J. Peggie; P/O. W. M. Pepper.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED ON ACTIVE SERVICE.—Sgt. J. N. Hallam.

WOUNDED OR INJURED ON ACTIVE SERVICE.—Sgt. H. E. Peters.

DIED OF WOUNDS OR INJURIES RECEIVED ON ACTIVE SERVICE.—Sgt. C. T. Martin.

Royal New Zealand Air Force

WOUNDED OR INJURED IN ACTION.—P/O. H. S. Pettit.

MISSING.—Sgt. M. J. Cronin; P/O. R. C. Davis; Sgt. H. C. Downs; Sgt. C. P. Goulding; Sgt. K. R. Taylor.

South African Air Force

KILLED IN ACTION.—Air Sgt. B. E. Lea; Air Sgt. J. H. Van Dyk.

WOUNDED OR INJURED IN ACTION.—Air Sgt. Graham; 2/Lt. D. L. Norton.

MISSING, BELIEVED KILLED IN ACTION.—Air Sgt. B. M. Gerrand; 2/Lt. J. E. M. Goodwin; Air Sgt. H. J. Oosthuizen.

MISSING.—Lt. R. F. Loffhagen.

PREVIOUSLY REPORTED MISSING, NOW REPORTED PRISONER OF WAR.—2/Lt. A. Luow.

Casualty Communique No. 114.

Royal Air Force

KILLED IN ACTION.—Sgt. J. W. Adey, Sgt. J. R. Appleby; Sgt. F. H. Brooke; Flt. Sgt. J. A. Bunting; Sgt. A. J. Copping; Sgt. H. Davies; Sgt. R. W. Dobson; Sgt. D. A. Forder; Sgt. A. Hibbitt; Sgt. L. A. Jardine; Sgt. M. Jones; Sgt. A. D. Jory; Sgt. F. G. Maple; Sgt. D. Marsden; Sgt. H. B. Metcalfe; Sgt. K. E. Northrop; P/O. D. B. Peace; Sgt. C. D. S. Stewart; Sgt. P. C. Wells; Sgt. A. B. Wright.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—P/O. N. C. Alers-Hankey; Flt. Sgt. T. C. E. Berkeley; Sgt. R. Carr; Sgt. N. E. H. Coleman; Flt. Sgt. C. G. Goodfellow; Sgt. J. Grasson; Sgt. R. W. Gray; Flt. Sgt. A. E. Hammond; Sgt. L. J. Harrison; Sgt. B. Hassall; F/O. R. James, D.F.C.; Sgt. B. F. T. Johnson; Sgt. H. A. Kelly; Sgt. T. A. Parkes; P/O. H. H. Pearson; L.A/C. M. Swain; Act. Sqn. Ldr. M. L. Watson; P/O. P. G. C. Wood; Sgt. J. K. Young.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Sgt. B. Akrigg; Flt. Sgt. J. F. Armitage; Sgt. H. Bailey; Sgt. E. Binns; Sgt. K. C. Bisson; Sgt. R. D. Carvill; P/O. S. Cook; Flt. Sgt. R. L. Cox; Sgt. T. Dean; Sgt. P. K. Eames, D.F.M.; Act. Sqn. Ldr. F. L. H. Eddison; P/O. A. L. Gordon; Sgt. W. G. Halliday; Sgt. E. L. Holmes; Sgt. J. Holt; Sgt. H. T. Ivory; Sgt. W. Kelly; P/O. D. S. W. Lake; Sgt. V. A. Lewis; Sgt. S. A. Loveday; Sgt. S. W. R. Mabbett; Sgt. T. H. Marquis; Flt. Sgt. J. R. Massey; Sgt. J. A. Oxley; Sgt. C. Paton; Sgt. R. C. Rae; Sgt. D. E. Richardson; Sgt. R. O. Rintoul; Flt. Sgt. J. S. Robertson, D.F.M.; P/O. R. G. Sammons; P/O. A. F. Sharp; Flt. Sgt. J. H. Simpson; P/O. M. R. Stephens; Sgt. K. Tait; Sgt. J. Till; P/O. D. W. H. Walker; Sgt. P. J. Walker; P/O. I. W. Watson; Sgt. J. Welsh; Sgt. A. F. Wilson.

WOUNDED OR INJURED IN ACTION.—Sgt. V. R. Baker; Sgt. R. H. P. Matthews; Sgt. W. A. Millward.

MISSING, BELIEVED KILLED IN ACTION.—Act. Flt. Lt. H. F. Dukes-Smith; Sgt. B. Froude; Sgt. D. L. Groves; Flt. Sgt. A. Hussey; Sgt. P. A. Ingram; Sgt. D. B. McLaren; Sgt. H. Moren; Sgt. L. B. Nourse; F/O. C. B. Randall; Sgt. A. H. Shattock; Sgt. A. R. W. Smith; P/O. R. H. Thomas; Sgt. A. J. Wratton.

MISSING.—P/O. A. C. Argent; F/O. G. R. Bayley; P/O. C. H. Bert; Sgt. B. Bowring; Sgt. P. L. Chapman; Sgt. J. J. Clarke; Flt. Sgt. R. Collins; P/O. L. E. Cook; P/O. C. H. Curtis; Sgt. F. E. Dunn; P/O. G. T. Ellis; Flt. Lt. H. A. Farthing; Sgt. J. V. Gardner; Sgt. W. Giles; Sgt. R. V. Griffiths; Sgt. A. H. Hancox; Sgt. A. G. Harris; Flt. Sgt. B. L. Hart; Sgt. F. R. Isaacs; Sgt. J. E. Jones; Sgt. R. J. Kennedy; Sgt. A. L. Lax; Sgt. H. G. Lunan; Sgt. W. E. Mabbett; Sgt. H. W. Mantle; P/O. A. C. Marchbanks; Sgt. J. Mayes; Sgt. R. C. Meilings; A/C.1 J. Monro; Sgt. J. B. Myers; Flt. Sgt. M. T. O'Brien; P/O. K. A. Parslow; P/O. A. C. Pickett; Sgt. D. A. Richards; Flt. Sgt. G. J. Sharp; P/O. B. Sides; Sgt. A. S. Spackman; Sgt. W. J. Sullivan; Sgt. J. T. Thom; Sgt. N. Viner; Sgt. E. S. Swingler.

MISSING, BELIEVED KILLED ON ACTIVE SERVICE.—Sgt. F. Coakley; Sgt. C. Dunn; Sgt. M. York.

KILLED ON ACTIVE SERVICE.—Sgt. R. S. Aitchison; A/C.1 St. C. B. J. Andrews; Cpl. H. L. Baldwin; Sgt. T. G. Banks; Flt. Sgt. A. Buchanan; Sgt. C. D. G. Christian; A/C.1 J. Corlett; P/O. T. D. Dawson; Sgt. G. De Renzi; Sgt. R. F. Doman; F/O. H. E. C. Elliott; Flt. Sgt. L. T. Frisby; Sgt. T. F. Greenwood; L.A/C. G. I. Hanson; L.A/C. S. J. Harris; L.A/C. B. G. Harrison; L.A/C. K. L. Henry; L.A/C. R. E. Henson; W/O. J. Hopewell, D.F.M.; L.A/C. E. Hopkin; L.A/C. W. L. Ibbs; L.A/C. W. Jones; L.A/C. A. B. Kinnear; Sgt. R. J. Latham; Cpl. A. E. S. Murray; L.A/C. T. S. Ridley; Sgt. M. P. Rusk; P/O. H. L. Tarbitten; Sgt. R. D. Telling.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED ON ACTIVE SERVICE.—A/C.1 R. S. Hodgson; A/C.1 R. L. Ward.

WOUNDED OR INJURED ON ACTIVE SERVICE.—Sgt. C. W. Cragg; Act. Flt. Sgt. L. V. Davies; P/O. T. L. Kinsey; Sgt. W. P. Tugwell.

DIED OF WOUNDS OR INJURIES RECEIVED ON ACTIVE SERVICE.—A/C.1 J. W. Partington.

PREVIOUSLY REPORTED WOUNDED, OR INJURED ON ACTIVE SERVICE, NOW REPORTED DIED OF WOUNDS OR INJURIES RECEIVED ON ACTIVE SERVICE.—A/C.1 J. F. Foxall.

DIED ON ACTIVE SERVICE.—L.A/C. A. Marshall; Sgt. A. C. Thompson; A/C.2 A. Culley; A/C.1 W. T. Deanos; L.A/C. D. Millar; L.A/C H. Nightingale.

Women's Auxiliary Air Force

DIED ON ACTIVE SERVICE.—A/CW.2 I. Ralph; A/CW.2 F. A. Swift.

Royal Australian Air Force

KILLED IN ACTION.—Sgt. P. Dive; F/O. D. Hughes; Sgt. E. J. J. Silk.

WOUNDED OR INJURED IN ACTION.—P/O. J. G. Gorton.

MISSING.—Sgt. P. C. H. Goldie; Sgt. W. R. Seymour; P/O. J. F. Stanfield; Sgt. E. H. Thompson; Sgt. N. M. Toohill.

MISSING, BELIEVED KILLED ON ACTIVE SERVICE.—P/O. E. R. Parke.

Cleaning Vickers K guns in the armoury.

KILLED ON ACTIVE SERVICE.—L.A/C. M. Neylon; P/O. S. S. White; Sgt. E. O'Connell; P/O. W. H. Lynch.

WOUNDED OR INJURED ON ACTIVE SERVICE.—Sgt. T. F. Jones.

PREVIOUSLY REPORTED MISSING, NOW REPORTED PRISONER OF WAR.—Sgt. D. Moorey.

Royal Canadian Air Force

KILLED IN ACTION.—Sgt. V. C. Dadson; Sgt. D. R. Campbell.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Sgt. W. M. Cadney; Sgt. E. W. Foxley; Sgt. V. E. V. H. Sewell.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Sgt. E. R. Berkey; Sgt. S. F. B. Bott; Sgt. E. J. Conry; Sgt. R. H. Crafts; Sgt. H. L. Crich; Sgt. J. P. Taylor.

WOUNDED OR INJURED IN ACTION.—Sgt. M. S. F. Schneider.

MISSING, BELIEVED KILLED IN ACTION.—Sgt. J. W. Colpitts; P/O. F. C. Duggan.

MISSING.—Sgt. C. W. McL. Burns; Sgt. W. J. Elder; Sgt. R. B. Glover; Sgt. J. B. H. Hill; P/O. J. G. Scott.

MISSING, BELIEVED KILLED ON ACTIVE SERVICE.—Sgt. J. C. Ross; P/O. R. N. Wycherley.

KILLED ON ACTIVE SERVICE.—Sgt. J. S. Blaikie; A/C.2 E. C. Carley; Sgt. E. Eves; P/O. J. M. Marok; Sgt. A. J. Monserez.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED ON ACTIVE SERVICE.—P/O. R. S. Collis.

Royal New Zealand Air Force

KILLED IN ACTION.—P/O. P. M. Brewer; P/O. G. L. Hesketh; Sgt. L. W. Hunt; Sgt. T. W. Irving.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Sgt. J. D. C. Long; Sgt. K. Manson; P/O. S. C. Niven; P/O. G. P. L. Redstone; Sgt. G. Wells.

WOUNDED OR INJURED IN ACTION.—P/O. G. N. Bonham.

DIED OF WOUNDS OR INJURIES RECEIVED IN ACTION.—P/O. L. R. Farr.

MISSING, BELIEVED KILLED IN ACTION.—Sgt. K. J. Coakley.

MISSING.—P/O. D. J. Clifford; P/O. E. W. Cox; Sgt. A. W. Kerrish; P/O. K. J. McAneny; Sgt. N. B. Rankin; P/O. H. J. Woodrow.

KILLED ON ACTIVE SERVICE.—Act. Flt. Lt. P. H. Creswell; A/C.1 F. F. Edwards; Sgt. K. B. Rogers; Sgt. A. R. Wilson.

PREVIOUSLY REPORTED MISSING, NOW REPORTED PRISONER OF WAR.—Sgt. K. A. Commetti; Sgt. Ldr. A. D. Greer.

South African Air Force

KILLED ON ACTIVE SERVICE.—Lt. R. Ditchburn; 2/Lt. G. C. R. Jenkins.